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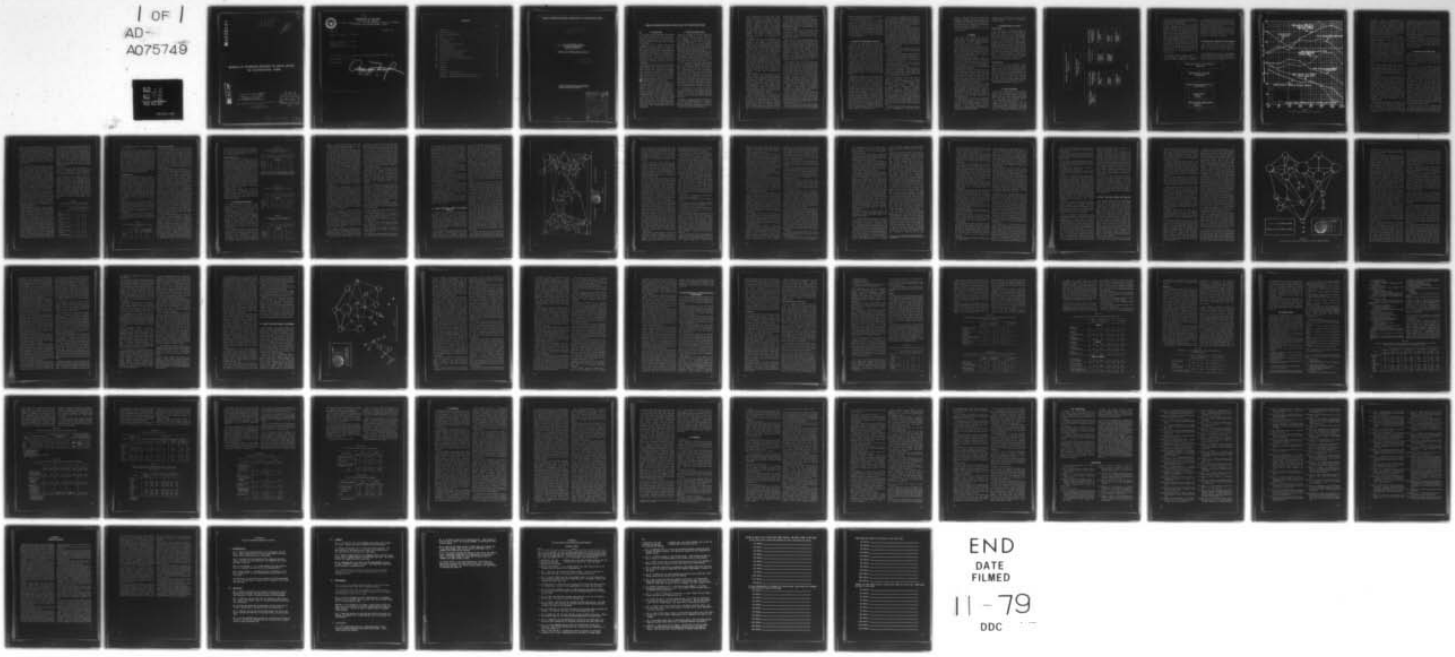

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MORALE OF WORKERS EXPOSED TO HIGH LEVELS OF OCCUPATIONAL NOISE

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(6) # MORALE OF WORKERS EXPOSED TO HIGH LEVELS OF OCCUPATIONAL NOISE

(11) 1955

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MORALE OF WORKERS EXPOSED TO HIGH LEVELS OF OCCUPATIONAL NOISE

I. INTRODUCTION

It has been history's unfortunate observation that each new technological era has produced materials deleterious to man's well-being. Lead, mercury, siliceous dust and, more recently, newer energy forms, have caused illness or death among workers.

Exposure to these dangers has aroused apprehension and reluctance to work. Yet, because of economic need and the allure of high wages, the worker has found himself in surroundings anathematic to his judgment and traumatic to his emotional structuring. Frequently, because of this, he has demonstrated short measure on the industrial yardsticks of efficiency – production, attendance, turnover, work quality, dependability, decisiveness, and punctuality.

In apposition to this usual kind of industrial experience was the hearsay at Tinker Air Force Base (TAFB) that employees in constant contact with the noise of jet engines undergoing test procedures demonstrated the "highest morale of any group on the base." Undocumented impressions were that the jet engine testers were superior in such measures as attendance, turnover, and dispensary visit rate and that they had unbounded enthusiasm for the job.

It was decided that such antithetical circumstances should be explored. If high morale were found and its determinants identified, the findings could have practical application to other Air Force job situations where adverse working conditions produced apprehension or reduced effectiveness. Also, insights into these relationships might result in better placement.

Proposed was a study of workers in high noise level areas, with appropriate control subjects from areas of average noise levels. The two groups were to be compared through a study of their work records, personal interviews, sociometry, and environmental noise level mensuration.

II. TINKER AIR FORCE BASE

What is the nature of the backdrop against which this investigation was set? When, in 1941, Oklahoma City was chosen as the area for development of a $14 million air depot, Central Oklahoma, like so much of the Southwest before World War II, was predominantly agricultural with little large-scale manufacturing. Petroleum was king, and no demands had been made for the open spaces where weather conditions would permit year-round flying.

Informed that the institution would be permanent and would employ an estimated 2,000 to 2,500 people, local business men offered the required 800 to 900 acres of land to the Government at no cost. At the time, there were only seven houses and ten barns on the property.

At the time of contract award, plans called for "a completely integrated Air Corps and Supply Depot including airfield, night lighting, gas storage, quarters and all necessary utilities." Included were 100 acres of buildings, four hangars (each 800 feet by 250 feet), and four runways (one 7,000 feet and the others 6,000 feet) built to withstand the impact of one-ton ships. The docks were to care for 200 planes and a bombproof storage plant was to be constructed underground. The estimated yearly repair load was set at 3,600 engines, requiring more than 3,500 civilian employees – a far cry from the 20,000 man plant currently in operation.

On 30 July 1941, at a temperature of 104°, the ground-breaking ceremony was held. The construction had its own industrial medical tragedies. One worker was killed when dirt caved in, and several others died when hangar doors fell.

Originally designated Midwest Air Depot, it was soon re-termed Oklahoma City Air Depot. In honor of General Clarence L. Tinker, it became Tinker Field, and finally was given its current title of Tinker Air Force Base.

The Maintenance Division, with whose personnel this study is concerned, repairs damaged aircraft and anticipates trouble by completely reconditioning engines at specified intervals. Engines are torn down to their smallest components which are cleaned, checked, repaired, or replaced, and assembled into new engines to be tested for performance in the test block. Other responsibilities include modifying new aircraft, changing existing armament, and making structural and other revisions too recent to be accomplished at the factory.

In March 1942 some 745 Oklahomans, inexperienced in aircraft mechanics, began training in San Antonio for assignment to Oklahoma City. In mid-September the airplane repair section of 900 employees was organized to repair B-17's, P-40's, and B-26's. On 11 November 1942, they began round-the-clock shifts. In July of 1942, the Engine Repair Section was started. It grew to include 13 branches, one of which was the Test Block.

As prospective engine testers, the 745 San Antonio–trained Oklahomans were hired by a newly opened employment office in Oklahoma City and sent to Kelly Field for further training. Upon their return, they were placed in test areas after interviews and physical examinations. Those selected were men who came from the automobile and heavy machinery industries, for they "knew something about engines."

The Oklahoma City Air Materiel Area at TAFB is one of eight such areas under the command of the Air Materiel Command (AMC), the largest of the major divisions of the United States Air Force. AMC is responsible for the development, production or procurement, supply, and maintenance of all the equipment and material needed to operate the Air Force (AF), including planes, engines, and related equipment. TAFB performs all functions except the development of planes and equipment.

These responsibilities are carried out by personnel in 121 locations, with operations in 20 states, involving activity in 744 plants. The $6.1 billions are distributed among 2,500 prime contracts and 22,000 subcontracts. Work is performed on bombers and cargo craft involving 8,655 different parts for numerous engines, 44,623 different parts for five varieties of airplane, and 215,164 miscellaneous items for such portions of the craft as armament, electrical systems, navigation instruments, etc.

The physical plant includes 570 buildings on four sections of land, served by 13 miles of roadways and airstrips, and 9 miles of railway. Initially the facilities and equipment cost $97,800,000 with a total estimated replacement cost of $147,500,000.

Served by OCAMA are air and ground crews throughout the AF, including 26 countries receiving grant aid, four classified as reimbursable aid, and more than 30 friendly nations under mutual security.

The first test house was constructed in 1945. Engine cells in separate rooms equipped with exhaust ventilation permitted the operator to be away from the noise and fumes, but still allowed observation of the engine operation through windows. Alongside each window was an instrument for the checking of idling run, oil temperature, generator voltage, cylinder temperature, oil pressure, and revolutions per minute at various loads. The hazard of exploding gasoline was counteracted by installing an underground gasoline storage system.

The Douglas Plant, built for the fabrication of C-47 aircraft engines, was located adjacent to Tinker Field with an eye toward postwar use of the plant by the depot. On 1 November 1945, through assumption of command jurisdiction, its 2,225,000 square feet of floor space were added to the Tinker area, creating the largest air depot in the world. Now it was possible to accomplish projects on large aircraft inside buildings, eliminating exposure of personnel and equipment to inclement weather, to provide adequate bulk storage space, and to transfer jet and gas turbine overhaul from San Bernadino to Oklahoma City. Through closer proximity of offices, it was possible to consolidate departments and achieve better coordination of activities and utilization of personnel.

Early in 1947, test cells were modified for testing jet engines. About this time, 11,500 civilian employees were at work at TAFB, and maintenance operations covered repair, installation, modification, and maintenance of B-29, C-54, F-47, F-80, F-84 and other aircraft, their engines and accessories.

The conversion to jet overhaul and procedures seemed to present no new work hazards except for the acoustic trauma in the Test Block.

Periodic audiometry was initiated for employees exposed to the high noise levels.

Work was started on the Area C jet engine test cells in February 1952 at a cost of $2,183,131. This modernization program incorporated many advanced features to combat the powerful thrust of the newer engines, and sound was controlled by special baffled exhaust stacks.

At the close of its first year of jet production, all conventional test cells had been converted, and on 31 December 1953 the field was manned by 21,920 employees.

III. NOISE IN CONTEMPORARY INDUSTRY

With the daily white-lining of our skies by jet planes, and with the term "jet" having invaded all speech descriptive of things fast, furious, frenetic, and fantastic, we have come to accept the jet engine as one of the components of our contemporary culture. With it, of course, comes noise. The picture has been painted well by Meyer (103) who wrote, "More automobiles on the highways, with more powerful engines and larger diameter tires, traveling at higher rates of speed, have increased the traffic noise problem; the use of larger and more powerful equipment in industry has been accompanied by a rise in noise levels generated; and the aviation industry, with the development of higher utilization of jet propulsion has created new problems relative to the effects of sound on man."

Exposure to noise can be evaluated by comparison of sound pressure levels in decibels. Average office noise is measured at an overall level of 40 to 60 db, and the usual noise of a street at 60 to 80 db is considered on most rating scales as "loud." A noisy factory averages 60 to 100 db. An airplane engine (reciprocating), at 1,600 revolutions per minute, provides a noise level of 115 db, 18 feet from the propeller. Heretofore, 120 db has been viewed as the threshold of feeling (varying with the frequency, though), and 130 db as the threshold of painful sounds, or the limit of the ear's endurance. The noise of a jet engine undergoing testing has been measured in excess of 140 db (2). Comparable only is the victory siren at 50 feet (140 db). Exceeding this is North American's F-100, estimated to produce between 176 and 180 db (3).

This presents a completely new variety of stress at work, exceeding in intensity most of the known noisy situations within industry's ken. Jets produce noise 10 to 20 db greater than World War II aircraft, and the situation is prognostic of greater noise to come.

How is this stress handled by the worker? What tolerance has he demonstrated? Miles (4) has concluded, following studies aboard the U.S.S. *Wasp* that "the most significant general fact applicable to the present (1953 version of the problem of noise) is that maintenance and other personnel now engaged in servicing and operating our jet planes appear to be efficient in their work and willing to continue in their jobs, and that the great majority of these men use no ear protection."

He writes further (5):

1. A condition of very high morale exists favorable to efficient teamwork in many if not all phases of jet-engine operations.

2. The majority of young men become acclimated to intense noise when it seems a necessary evil.

3. The majority of personnel working with jets do not wear ear defenders. This is a fact which may be interpreted in various ways . . . .

5. Personnel appeared to be well relaxed and emotionally flexible between stints of intense work. The sociability index seemed high.

Glorig (6) points out that "attitude influences adaptibility considerably. If the person concerned is an enthusiastic, willing worker with little or no dislike for the job, he is much more apt to adapt himself to the noise."

Davis (91) had this to say: "We can be annoyed by something, but a lift in morale makes us forget it. Something may be a bit unpleasant, but if we are determined to do the job, we put up with it . . . Motivation is so important and so variable that we cannot reasonably hope to measure objectively the effects of annoyance or of moderate fatigue." He adds, "Perhaps the total stress of a difficult situation, as in military operations, is so great that this little extra load is unnoticed and insignificant by comparison; but sometimes it may be that the stress of noise is one of several more or less equal loads. Then noise may well be the straw that breaks the camel's back."

Expressed by Miller (93) in more psychologic terms is essentially the same idea. "It is

suggested that, where noise is perceived and reported as harmful, this may be due to an accumulation of stressful stimuli and situations in which noise, because of its prominence in the stimulus field, is signaled out as the most onerous aspect of the environment."

In need of definition, then, is the behavioral entity "morale."

IV. MORALE

This term, used loosely and tightly, is applied often to the general spirit of a group as it is engaged in reaching a specific objective. That there is a close correlation between morale and group effort is well known.

During World War II, Katz and Hyman (7) found that the days needed by five different shipyards to turn out a ship varied from 57 to 207. They concluded that good production created a feeling of accomplishment, which in turn led to increased effort. Morale was related to factors associated with the job.

Perk (8) believed that "Morale is the barometer of the individual's and the community's capacity for suitable response to the call of duty and of the fortitude and tenacity displayed in the response." It may be exemplified by groups involved in disaster, such as the English during the Battle of Britain.

The concept of unity is stressed by several. Brown (9) felt that, "a group of persons is said to have good morale if that group is enthusiastically united in seeking a common goal." He quotes Tead who looks on morale as "that pervasive attitude of voluntary enthusiastic and effective mobilization of a group's efforts for the accomplishment of some purpose."

Many of the attitudes described in groups with high morale are those explored in this study. Included are such items as interest in the work, pride in doing a job well, a sense of accomplishment, active thinking of methods of improving the work done, pleasant relations of the workers with each other, and a positive attitude toward the immediate supervisors and plant management.

Recognizing group confidence and enthusiasm as necessary for morale, Learner (10) feels also that "An individual's estimate of his own prestige, status and satisfaction is more explanatory of the attitudes comprising morale than are the situational factors dependent on interactions with group members."

These kinds of intragroup reactions and relationships are the ones to be scrutinized closely at TAFB.

V. ORGANIZATIONAL PATTERN

The Study Group

The study group of workers engaged in testing jet engines was selected from the Engine Test Section of the Engine Branch. The Engine Branch is one of six branches comprising the Shops Division. This Division, in turn, is one of four responsible to the Assistant for Depot Maintenance, who is immediately under the Director of Maintenance Engineering. There are two test units and two storage and conditioning units (fig. 1). Of some 225 men on duty in these units, 50 were selected for interview. The line of authority courses vertically from Engine Branch Chief to Section Chief, to General Foreman to Foreman or Supervisor. Position title of the men studied were, Aircraft Jet Engine Tester, Grade 10; and Aircraft Jet Engine Tester, Grade 15.

The Control Group

Selected from the Parts Overhaul Section were 50 men for control purposes. These workers were all from the Welding and Miscellaneous Parts Unit, which is composed of two distinct sub-units, the Welding Sub-Unit, and the Nozzle Diaphram Rework Sub-Unit (fig. 2). The noise in their work areas was considered equivalent to average factory noise. Job titles of these workers included Junior Aircraft Welder, Grade 10; Aircraft Welder, Grade 15; and Grinding Machine Operator, Grade 10.

VI. NOISE EXPOSURE

The work areas housing the study group were measured for environmental noise with the General Radio Company Sound Level Meter Model 1551A and Octave Band Analyzer Model 1550. (The former was calibrated whenever necessary against a 60-cycle current.)

The octave band frequencies at which recordings were made were these: 25-75 cps, 75-150 cps, 150-300 cps, 300-600 cps, 600-1200 cps, 1200-2400 cps, 2400-4800 cps, and 4800-10000 cps. (Supersonic frequencies have been

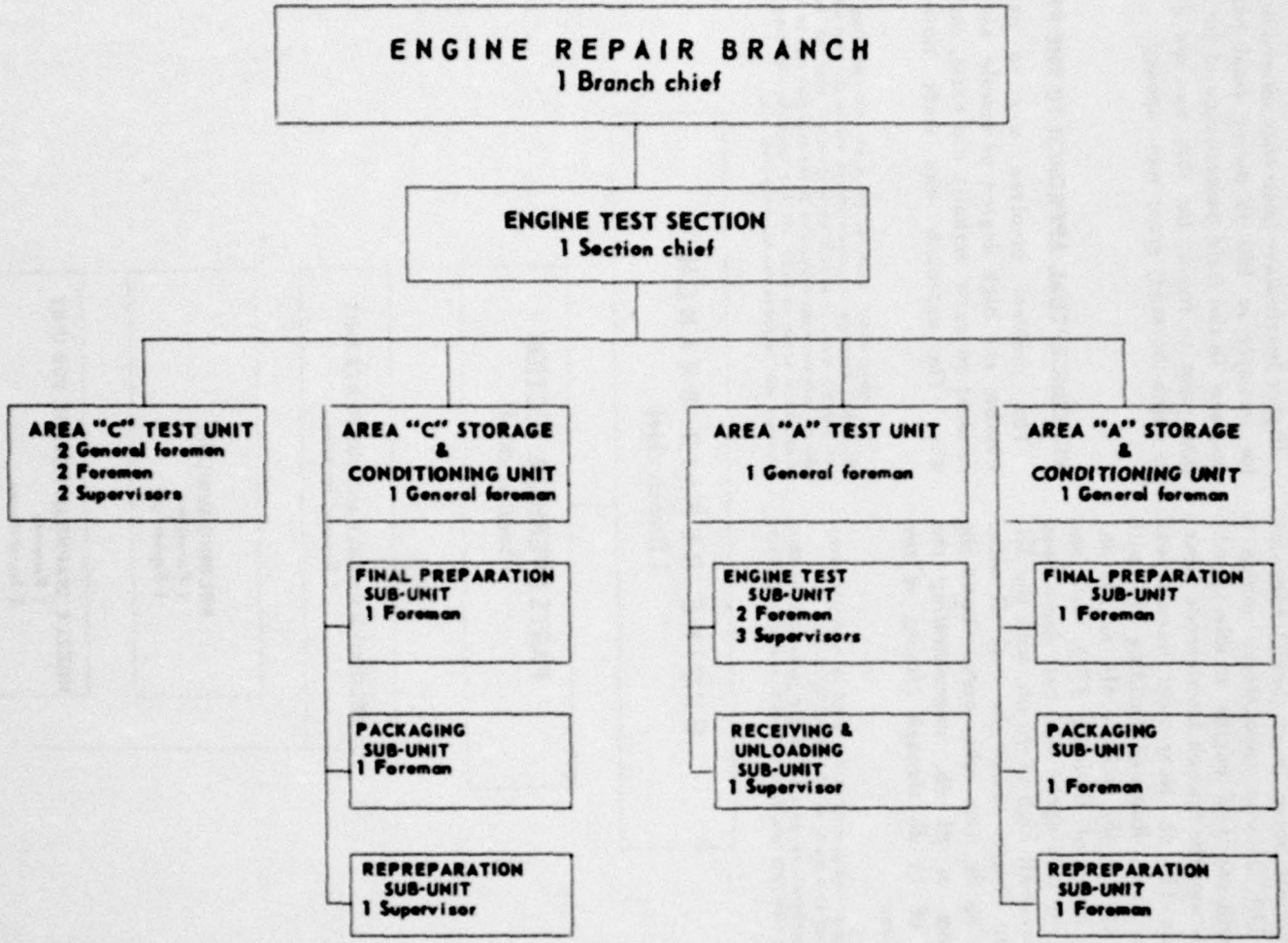
ENGINE REPAIR BRANCH
1 Branch chief
ENGINE TEST SECTION
1 Section chief
AREA "C" TEST UNIT
2 General foremen
2 Foremen
2 Supervisors
AREA "C" STORAGE & CONDITIONING UNIT
1 General foreman
FINAL PREPARATION SUB-UNIT
1 Foreman
PACKAGING SUB-UNIT
1 Foreman
REPREPARATION SUB-UNIT
1 Supervisor
AREA "A" TEST UNIT
1 General foreman
ENGINE TEST SUB-UNIT
2 Foremen
3 Supervisors
RECEIVING & UNLOADING SUB-UNIT
1 Supervisor
AREA "A" STORAGE & CONDITIONING UNIT
1 General foreman
FINAL PREPARATION SUB-UNIT
1 Foreman
PACKAGING SUB-UNIT
1 Foreman
REPREPARATION SUB-UNIT
1 Foreman

FIGURE 1

recorded on other occasions up to 40,000 cps, and it has been estimated that there are possibly frequencies up to 100,000 cps.)

As may be seen in figure 3, Jet Engine Testing, Buildings 214, 215, and 3703, the maximum over-all noise level (Sound Pressure Level) of 119 db was encountered inside a test cell, with one J-47 engine at idle speed.[1] Highest also was the Speech Interference Level (SIL)[2] of the 112 db. Next most intense was noted in the Ready Room of Building 215, with a maximum of 109 db, and the SIL at 101 db. The Ready Room of Building 3703, with one J-47 engine at idle speed and cell doors open showed an over-all high of 94 db, with the SIL at 86 db. In control rooms the over-all noise levels were 88 db. One other curve shows the Ready Room at 81 db, demonstrating the attenuation of 13 db through closing of the test cell doors.

[1]The microphone was placed at ear level in occupied areas, or at a center point in a room, at a height of 30 inches.

[2]The SIL represents an average of the recordings of three frequency bands: 600-1200 cps, 1200-2400 cps, and 2400-4800 cps.

In comparison with these noisy areas was the Parts Overhaul Section from which group were drawn the controls for this study. Rather typical factory noise was recorded here at an over-all level of 76 db, and SIL of 58 db.[3]

Higher levels have been encountered at TAFB, for example at 140 db during final phase adjustment in the field maintenance of jet aircraft just prior to flight, but this was not a source to which the study group was exposed.

VII. CONCEPTUAL APPROACH TO THE PROBLEM

The problem involved was to determine whether the high degree of morale which was rumored to exist actually did exist, and if so, why. The approach was made through the

[3]For what might seem to be a not too startling arithmetic difference between the noise levels within the test cells and in the control area, it should be pointed out that the decibel is a unit of measurement related to sound pressure and is based on a logarithmic scale to base 10. For example, doubling the sound pressure will increase the noise by 3 db only.

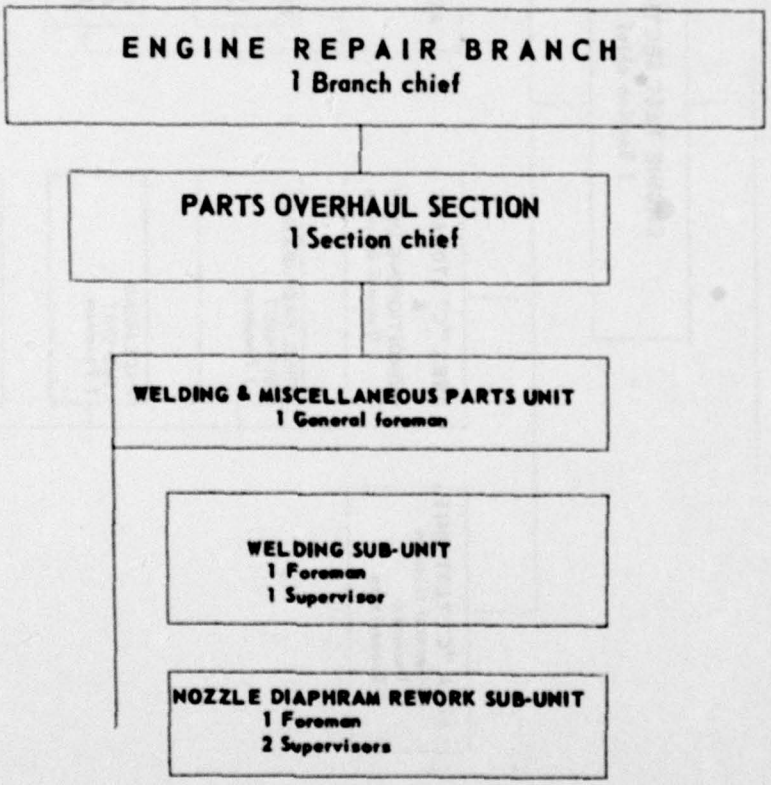

FIGURE 2

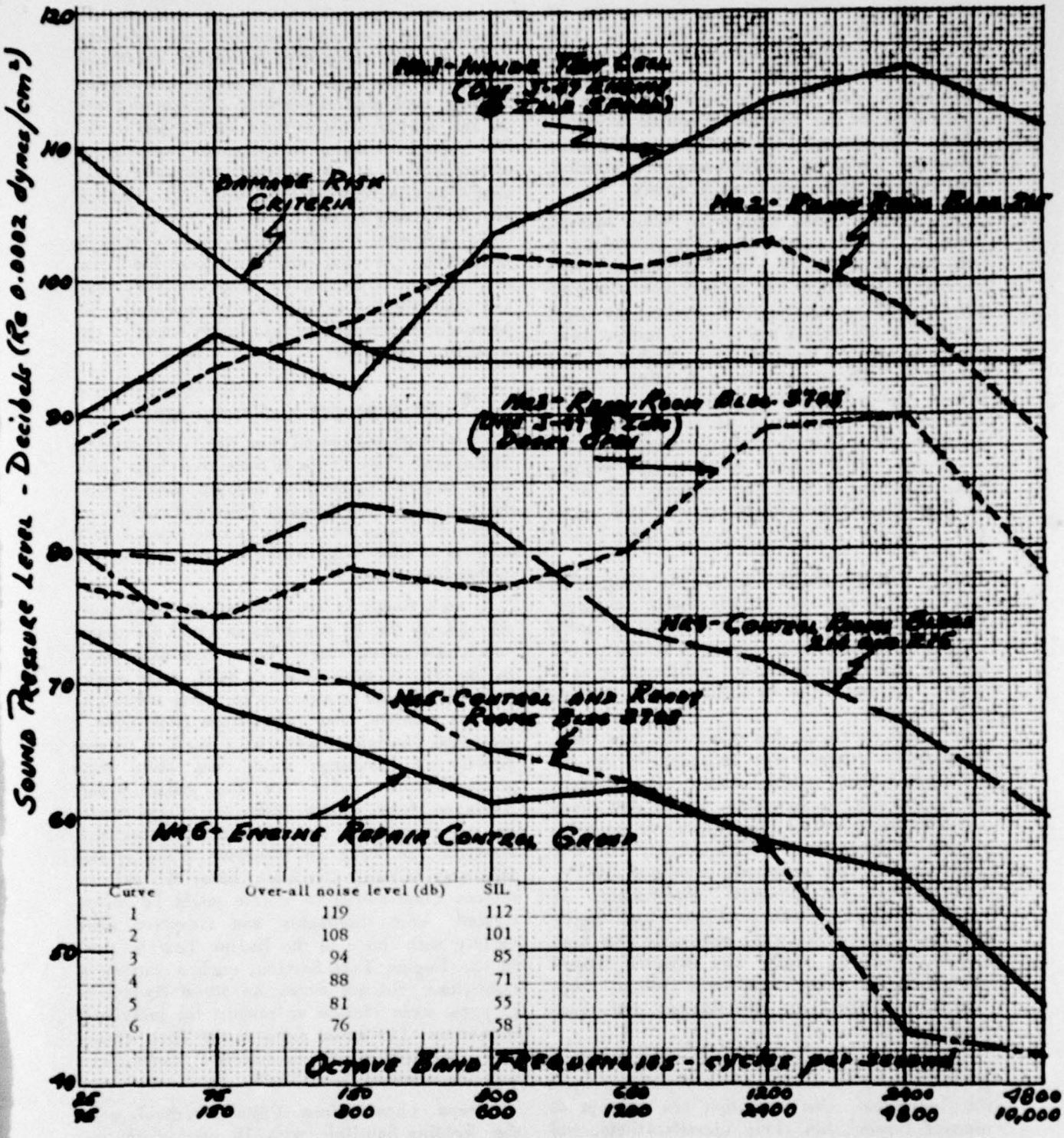

FIGURE 3

Jet engine testing – Buildings 214, 215, and 3703.

psychologic concept of ego-involvement as developed by Sherif and Cantril (11). This provided a means of integrating the various aspects of the study, suggested a testable hypothesis, and made possible the practical application to the problem of morale of established experimental findings concerning relationships among ego-involvements, aspiration, achievement, and group identifications.

Ego means many things to many writers. Here it will be used as a set of values or attitudes referring to "me" or "mine," with especial reference to occupational identifications. By an ego-involved worker, we imply one who is not merely practicing a certain trade, but who regards himself as a member of that trade. He fully accepts it in defining his own status and role in the economic and social structure, and regards it as an expression of his own skills, abilities, and personal worth.

As one TAFB worker said: "I like welding best. Because I feel I'm supposed to be a welder. That's the title I carry around, and I like to do it. I hope I'm a good welder; I think I am."

Ego attitudes which define the concept of self are necessarily affectively charged. Disparagement of knowledge or skill in one's *chosen* profession may arouse resentment, but one is more likely to remain indifferent if it is pointed out that he lacks ability in an *unrelated* line of work.

It is the thesis of this study that from these emotionally charged ego attitudes spring the behaviors from which morale is deduced. Experimentally, it has been shown that these attitudes are powerful determinants of the ways in which situations are perceived, the way goals are set, and standards evaluated (12-15). Thus, they are powerful determinants of behavior. It was hypothesized that a high degree of ego-involvement was necessary to high morale, and the study was directed toward evaluation of those conditions which, theoretically, affect the development of ego-attitudes (16).

Ego attitudes, as defined here, are learned – a product of the impact of social experience upon the individual. One develops his concept of himself through his group identifications, and he protects his self esteem and security by incorporating social values and by clinging to group norms. Therefore, to evaluate the development of ego-involvement in the industrial situation, this exploration concerned itself with social relationships as well as personality factors, and also the effect of both of these on the worker's perceptions of the job itself. The specific areas investigated were group relationships in the plant, supervisory and administrative relationships, work relationships, and personality factors.

To implement the project, sociometric studies were done, personal interviews were held, and a scale (the E-Scale) was especially devised and administered to assess experimentally the presence or absence of ego-involvement of the workers in their jobs.

VIII. SUBJECTS AND THEIR JOBS

Interviewed and tested were 105 TAFB civilian employees. Fifty of these were from high noise areas in the Engine Test Section, and 55 from the Parts Overhaul Section. Twenty of these subjects – 10 from each of the two sections – were used in a pilot study which set the pattern for further interviews.

It was found in the preliminary interviews that among the 12 sub-units in Parts Overhaul, conditions varied widely. There were differences in the type of work, level of skill, wage scale, supervision, and opportunity for group formation. It was evident that information from even a stratified sample drawn from such a heterogeneity of groupings could not yield much generalization valid for the entire plant. Averages from widely differing groups would be representative of none. It was decided, therefore, to make an intensive study of two sub-units in Parts Overhaul, where the various factors contributing to morale might be investigated more thoroughly and compared more validly with those in the Engine Test Section. In the Engine Test Section, such a variety of conditions did not exist, so 50 of these employees were chosen at random for individual interviews. The entire group in the Test Section was included in the sociometric studies and was administered the E-Scale.

Groups chosen from Parts Overhaul were the Welding Sub-Unit, with 18 employees, and the Nozzle Diaphram Rework Sub-Unit with 29 employees, both of which were divisions of the

Welding and Miscellaneous Parts Unit (see figure 2). These were chosen after a survey of all Parts Overhaul Operations conducted with a job analyst who had just completed job descriptions for the entire section. For purposes of this study, he rated all jobs according to degree of repetitiveness, placing each in one of three categories – repetitive, average, or diversified – according to the number of operations involved.

As shown in table I, these three job categories, the skill required, and wage schedule were so distributed in the Engine Test Units and the two Parts Overhaul Sub-Units, that some comparisons could be made among groups which varied in repetitiveness of operation, while wage and skill remained constant. Salary is determined by grade, and grade is determined by the skill required for the operation. Within the grade are four step raises, and the step three raise is the most representative of the salary of the employees interviewed. Salary for Grade 10, step three, is $3,785.60 per annum, while for Grade 15, step three, it is $4,243.20.

Supervision in the Welding and Miscellaneous Parts Unit was rated by the Branch Chief to be comparable to that in the Engine Test Unit, although the rating in each case referred to the general foreman, who was two steps removed from the worker. The worker's immediate superior was a supervisor who worked under a sub-unit foreman, who was responsible to the unit general foreman.

What has been termed the "social geography" of the working arrangements differed greatly between the Parts Overhaul and Engine Test groups. In Engine Test, work was accomplished in groups. An Operator, Grade 15, and Recorder, Grade 10, accompanied part of the time by a supervisor, and checking with an inspector assigned to them, worked together to test the same engine. The engines were prepared for testing and removed after testing by men working in groups of three to six. With the exception of one welding operation on aft frames, where two and sometimes three men worked together, the welders worked alone. The welders used individual booths, and they were cut off further from social contact by goggles and hoods. The grinders also worked in separate booths and wore goggles. All groups had an equal opportunity for association during lunch periods and the two daily ten-minute smoke breaks. One of the reasons for selection of these groups for study was that they afforded an opportunity for investigation of the effect of widely differing work arrangements on group formation among the workers, and its possible relationship to morale. The groups chosen were comparatively small, so it was possible to make intensive studies of each, which was felt to be more valuable than only one such study on a single larger group.

All workers in the study were subject to a system of "loan-outs" in which they were sent to work temporarily in other departments, when the work load in their own unit was slack.

Noise intensity varied widely between the Engine Test and Parts Overhaul groups as indicated previously. The welding and the grinding done in the Nozzle Diaphram Rework Sub-Unit were not silent operations, but the noise was average, and the unit was not regarded as unduly noisy by the workers themselves, or by those in adjacent units, as were certain machining operations. The sound of welding serves a useful purpose to the welders who reported that they were alert to its variations as diagnostic of the quality of the weld.

TABLE I

Skill requirements in study and control groups

	Repetitive	Average	Diversified
Grade 5:			
Engine Test Unit	3	0	0
Welding	1	0	0
Nozzle Diaphram	2	0	0
Grade 10:			
Engine Test Unit	0	8	25
Welding	6	1	0
Nozzle Diaphram	27	0	0
Grade 15:			
Engine Test Unit	0	0	14
Welding	0	0	10
Nozzle Diaphram	0	0	0

"A good weld," said one, "is a Sizz, and a bad one is a Swish."

The Engine Test Section at TAFB was divided into two separate branches with identical functions, one in Area X and one in Area Y. The total number of employees in Area X at the time of the study was 113, while in Area Y it was 112. Their distribution according to sub-units is shown in table II. In each area, Storage Units and Test Units were housed separately. Since employees in the Test Units underwent greater exposure to noise than those in the Storage Units, most of the interviewees selected were from the Test Unit, although both units were part of the Engine Test Section.

Testing Operations

Operations in the Test Units included two separately identifiable but merging work activities: preparation of the engine for testing, and the testing operation itself. Testing was accomplished by an Operator, Grade 15, and a Recorder, Grade 10. The Operator was in charge of the cell where the engine was tested, and his job carried responsibility for the engine. Testing consisted of operating the engine from a control room, and recording information about its performance from instruments read during the testing. Notations were made as to its serviceability, need for repairs, and repairs required.

While there was some technical distinction between the duties of Recorder and Operator, and the Operator was charged with responsibility for the cell, in actual practice the duties were rotated between the two workers, and the Recorders assumed responsibility along with the Operators.

"The Operator is supposed to be responsible," said one Recorder, "But I don't know why they say that. If anything goes wrong, I am in it as deep as he is."

TABLE II

Number of employees by unit and area in engine test section

	Test unit	Storage and conditioning unit
Area X	56	57
Area Y	59	53

Preparation Line Operators

On the preparation line, engines were prepared for testing. Installed were by-pass lines, pressure fittings, aft frame vents, etc. Various checks were made, and the engine was placed in a frame and rotated to dislodge any foreign object, a process referred to by the workers as "burping the engine." These jobs, too, were interchanged, and all men on the preparation line were qualified to do any of them. This work was classified as Grade 10, and designated on the repetitive-diversified continuum as average.

From these workers are recruited the Recorders who eventually might become Operators. A number of the Recorders were engaged in both recording and engine preparation. In addition to those in Grades 10 and 15 shown previously, the units also employed several laborers and helpers, Grade 5, and inspectors, Grade 17. In Area X, a separate sub-unit was charged with loading and unloading engines.

The work of the Grinders in the Nozzle Diaphram Rework Sub-Unit was described as repetitive. It consisted of a hand-grinding operation, with power tools, on nozzle diaphrams and their blades. Cracks in these parts were ground out in preparation for welding and were smoothed over after the welding operation. The grinders, like the welders, worked alone in booths. This was specialized work which required close attention, and carried Grade 10, which indicated that the degree of skill required was as great as that required of Recorders and preparation line workers in the Engine Test Section. In this unit there was one turret lathe operator who made cuts to true up the machined surfaces on the nozzle diaphrams, also Grade 10, and one helper, Grade 5.

In the Welding Sub-Unit were found jobs designated as either diversified or repetitive. All repetitive jobs were classified as Grade 10, and consisted mostly of one type of welding (heliarc) which was done on combustion chambers and their inner-liners. The Grade 15 welding jobs were described as diversified and included different types of welding required by the various metals of the engine parts. The differing types of welding jobs were rotated among the workers according to a schedule. The rotation system was favored generally by the welders who pointed out that it gave them an opportunity to learn more about the trade.

Said one welder: "If you don't like a job, you know you aren't stuck with it, and when you get a new one, you know that if the other fellow has been doing it, you can too."

Group Characteristics

The distribution by birthplace, age, and educational level for each of the three groups, with the totals, is shown in tables III, IV, and V. Examination of the tables shows no striking differences among the groups. Compared with the other two groups, more of the Engine Testers were born in Oklahoma, while more of the Welders were from adjacent states. A larger percentage of the Grinders was in the 20 to 29 years age group, while the Engine Testers had a greater percentage in the 30 to 39 years division. The Welders had gone farther through school, with 19 percent reporting some college education, as compared with four percent by the other two groups. The Grinders, however, reported a smaller percentage as not having completed grade school.

These tables indicate that the subjects interviewed were a homogeneous group. The majority of them came from farms and small towns in Oklahoma, and most of them fell into the 30 to 50 years age group and reported some high school education.

IX. GROUP RELATIONS STUDY

In studies of morale in industry, social factors frequently are in evidence, as noted previously, and usually investigators list opportunity for social contact as one of the elements contributing to job satisfaction.

Early writings by Mayo (17) emphasized the relationship between the feeling of belonging to a group and the general level of employee morale. In one investigation, Mayo (18) attributed an improvement in morale to the introduction of rest periods which gave the formerly solitary workers an opportunity for socialization and development of a group consciousness.

In a recent observation of assembly line workers, Walker and Guest (19) noted the opportunities for conversation afforded by the assembly system. Although on a formal questionnaire few men checked "chance to talk to others" as a reason for liking their jobs, the authors concluded from the qualitative

TABLE III

Distribution of workers interviewed – by birthplace and group*

Birthplace	Oklahoma	Adjacent	Southern	Northern
	(percent)			
Test Unit	72	14	8	6
Welding	57	31	6	6
Grinding	66	17	7	10
Total	68	18	7	7

*Adjacent states: Texas, Arkansas, Missouri, and Kansas; Southern states: Alabama, Louisiana, Mississippi, and Virginia; Northern states: Illinois, New York, Washington, and Wisconsin.

TABLE IV

Distribution of workers interviewed – by age and group

Age	20-29	30-39	40-49	50-59	60-69
	(percent)				
Test Unit	15	50	19	10	6
Welding	18	41	29	12	0
Grinding	24	38	26	6	6
Total	18	44	23	10	5

TABLE V

Distribution of workers interviewed – by educational level and group

	Grades 1-7	Grades 8-12	Grades 13-14
	(percent)		
Test Unit	18	78	4
Welding	19	62	19
Grinding	12	84	4
Total	15	78	7

remarks in personal interviews that such contracts had an important influence upon attitudes of workers toward their jobs.

An attempt was made in the present study to approach this problem systematically and to investigate the hypothesized relationship between group formation and ego-involvement as a factor in morale. An increasing amount of research has been done in recent years, first by sociologists and later by social psychologists, on the dynamics and formation of informal groups (20, 21, 22). Many of these explorations have been of street corner gangs, not because the primary interest was juvenile delinquency, but because they provided an opportunity to study the spontaneous rise of group structure, the development of group norms, and the consequent regulation of individual activity in accordance with group values and attitudes. From these studies, principles have been derived that are applicable to the understanding of larger and more conventional societal units, all of which are developments of informal groupings.

Fundamental to group formation are common motivations and goals. Wherever people with common interests are thrown together, a group structure arises inevitably, characterized by the emergence of leaders, a hierarchical status structure, and the development of group norms. Individuals identify themselves as group members and incorporate group standards as their own personal values. These identifications and standards become a part of the person's own affectively toned ego-attitudes, and his behavior is regulated, thereby, in all matters of concern to the group (16).

From this viewpoint, group relationships should be of fundamental importance to the understanding of the problem of morale. The attitudes of the worker toward his job, his ego-involvement with it, his work standards, and activities may be related directly to the group of which he becomes a part. The degree of group structure among the workers – or lack of it – may have important implications for individual worker morale.

The problem of group relationship was approached in this investigation by two methods: personal interview and sociometric study. In the personal interview, workers were encouraged to talk about their social contacts by such questions as: Tell me about the people you work with. What kind of people are they? How many people do you have to contact every day in order to get your work done? How many do you speak to or have conversation with? If someone in your unit does not show up for work, do you know it? How long does it take for the news to get around? Do you talk shop? These questions were used as starting points to elicit the attitudes of the workers toward each other, and the kind and extent of their social contacts. Leads which they mentioned were followed up, and they were asked to explain their comments.

The second method of investigating group relationships was through sociometric study from which were constructed sociograms, a Moreno technique (23). The sociogram yields information pertaining to group structure, leaders and dominant figures, integration and cleavages, clique formations, amount of social interaction, and hierarchical status of the members.

After the personal interviews, workers in the Engine Test, Welding, and Grinding Units were assembled in groups and administered the sociometric questionnaire and E-Scale. It was felt that more valid information could be obtained on the written questionnaire if it were given after the interview, during which rapport could be established, and the worker had an opportunity to satisfy any question he might have about the purpose of the study.

In the sociometric questionnaire, subjects were asked to list their friendship preferences among members of their unit, according to four criterion questions:

1. If you could ride to work with anybody you like, whom would you choose?
2. If your foreman were to be absent for several weeks, whom would you recommend to take his place while he was gone?
3. Whom would you prefer to eat lunch or play cards with?
4. Suppose you want advice about a problem that comes up on your job – whom would you talk it over with?

The subjects were requested to make at least three choices and, then, as many more as they desired.

Sociograms are constructed on the basis of one criterion question. The fidelity with which

the sociogram reflects the actual social structure, and the amount of information it yields, are dependent wholly upon the type of question asked. It must be one which refers to real opportunities for association, and one in which choices may be based upon the respondent's true feeling, rather than upon some objective or limiting factors of the situation. Questions are expressed in the conditional mood. They must be designed especially for the type of group to which they are administered.

Because of these considerations, and because it was not practical to pre-test, four questions instead of one were used, in order to increase the probability of identifying the one which would give the needed information.

Discussion by the workers at the time the questionnaire was given showed that questions 2 and 4 were too structured to be helpful. For the most part, these questions reflected merely the standard practices in the plant.

The situation described in question 1 was not regarded by the workers as an opportunity for social contact. Their choices of *whom to ride to work with* were determined by these considerations: who was a good driver; whose car would hold up; who was dependable; and who lived in their part of town.

Question 3, however, referred to a concrete, continually experienced situation, in which choices were made freely. It was, therefore, on the basis of this question that the sociograms were constructed.

X. GROUP RELATIONS AMONG THE ENGINE TESTERS

In figure 4 is presented the sociogram for the Test Unit in Area Y, in the Engine Test Section. Each circle represents a respondent, and the size of the circle reveals the number of times he was chosen, as indicated in the legend. The lines connecting the circles represent choices among the workers, and the direction of the choice is indicated by arrows. The individual subject is identified by the number in his circle.

The striking thing reflected in the Test Unit sociogram (fig. 4) is the integration of the entire group. There is a rich number of interconnections reaching into every smaller subdivision and to every member, which weaves the group into an organized unit. There are no breaks in continuity, and the interconnections reach through and around the entire configuration. Smaller groupings, or cliques, may be identified by triangular and square arrangements. There are many of them, but the relationships within the cliques are subordinate to the outgoing relations among them. There are more lines of contact between, than within, the clique arrangements. There are dominant figures, indicated by the larger circles, but the pattern of leadership is not highly defined. The cliques are definite, but loosely knit. There are no cleavages between subgroups. In such a situation, jealousies and sub-group hostilities are not likely to develop. Expansiveness and cohesion take precedent over sub-group rivalry. This is a situation in which the group members react in terms of their experiences with one another, and loyalties belong to the group as a whole.

The sociogram divides itself into three groupings. Distance between these has been exaggerated to clarify the nature of the group structures. With the exception of one operator, the grouping at the extreme right represents recorders and workers who prepare the engine for testing, with their inspectors and supervisors. The extreme left grouping, with the exception of one preparation line worker, represents operators and recorders, with their supervisors and inspectors. In the central grouping are one operator (No. 17), three recorders (Nos. 21, 22, 23), one inspector (No. 19), and one helper (No. 20). The inspector and helper represent mobile positions; each has contact with different plant operations, and their choice lines reach in both directions. The position of the three recorders illustrates the integrating influence of this group. Originally they were recruited from the preparation line and later were working with both the preparation crew and the engine testers. It is interesting to note that one of the dominant figures in the central group, No. 20, is a helper, Grade 5, who is outranked by most of his fellow workers in salary and authority. Apparently, salary scale does not set up prestige barriers in the Test Unit.

It will be seen that the circles in the group on the right, the preparation line, tend to be larger than those in the group to the left, which represents operators and recorders. This finding

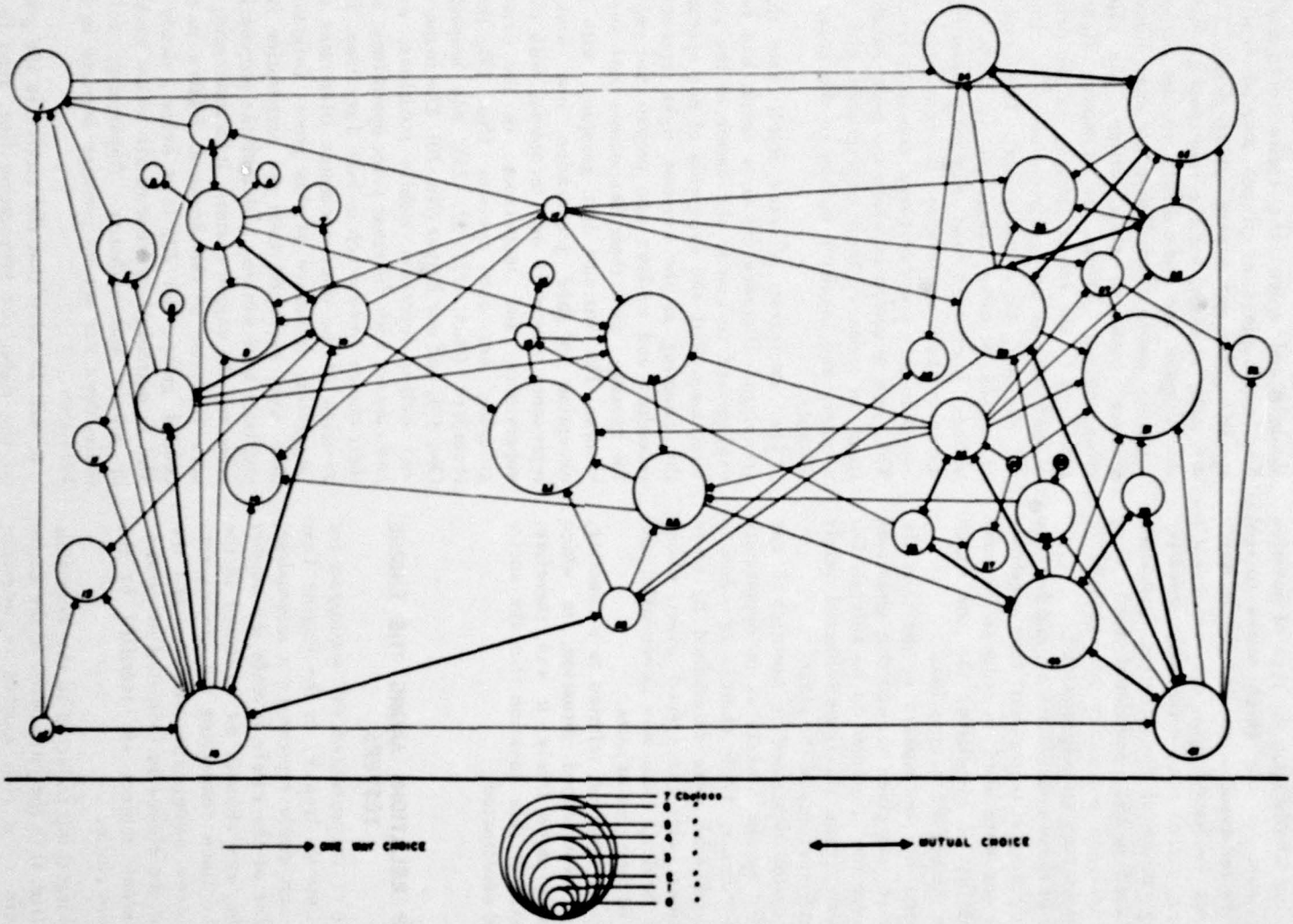

FIGURE 4

Selection of lunch and card game companions by Engine Testers.

may be related to the fact that employees work in larger groups on the preparation line, and, therefore, leadership qualities have a greater opportunity for emergence. On the line, the preparation of the engine is the result of the cooperative effort of from three to six workers, while only two work together continually in the test cell.

Another indication of the vigorous cohesiveness of this group is the fact that the great majority received multiple choices. With the possible exception of one worker who received no choice, and who is not represented on the sociogram because, apparently suffering from a reading disability, he did not complete an intelligible questionnaire, there are no complete isolates in the test cell.

Seven received only one choice. Of these, three were supervisors and foreman who usually take lunch together in their own offices. The sociogram shows that the number of outgoing choices does not diminish as incoming choices, or popularity increases. Those receiving a great number of choices make, on the average, as many choices as those who are chosen less frequently. Here, prestige does not breed exclusiveness. The total picture is one of a freely accepting, expansive group, where common interest would be expected to be strong, and antagonism to be at a minimum.

In the personal interviews, liking for their fellow workers was one of the most frequently mentioned reasons given by Engine Test employees for liking their jobs. In most cases, these feelings were expressed spontaneously without specific questioning by the interviewer. Only three of the 50 who were interviewed expressed anything like criticism of other workers. One of these said: "As a whole, we do all right, but like every place else, we do some awful dumb things sometimes. If you train somebody and work with them and you test each other and check each other's work, then it is OK. Then they change and give you somebody who doesn't know what they are doing and is slow and deadheads around and that causes everything. A lot of men here get lost waiting on each other."

Most of the workers, however, stressed the cooperation, ability, willingness of others to help, and a teamwork relationship which they enjoyed: "The test block as a whole works together and helps each other. We go to the other fellows and they come to us. There's coordination between the boys. They work like a team. We have all got to work together."

Comparing his job with one held formerly in another department, one worker explained: "Everybody has to cooperate. Workers here are much more congenial. In other jobs, it is production line work. That creates a bad feeling and you get on edge and are grouchy and don't cooperate. In Engine Test you have to figure out what is wrong and everybody puts in his guess. On the production line, one person does his own job. Here we work together. It is our job as a team to get the job done. You have to cooperate to get production. There is a necessity for getting production out and cooperating."

Others spoke of a democratic atmosphere: "I know practically everybody by sight. Seems like most of them work together well. Really better than average. In other jobs, usually there are one or two who think they are far ahead of the others, but here nobody thinks that way. Doesn't seem like it. The work is greasy so they can't come all dressed up like they do on some jobs. We just have to wear old dirty clothes. We are all dirty together and we can't help it."

They spoke of interdependence, mutual help, and sharing of responsibility:

"They are nice fellows. Everyone does his share."

"Cooperation couldn't be improved. Operator and recorder take equal responsibility. We jaw at one another, but we don't get mad."

"Everybody would work overtime without pay. I've stayed 40 or 50 minutes to finish something that others couldn't do."

The sociometric findings and the men's own testimony describe a highly cohesive group of workers, conscious of their group membership, and of the teamwork character of their jobs. Theoretically, the basic properties which characterize such an informal group structure are common motivation or group goals, group norms which determine and regulate attitudes and behavior in matters of interest to the group, and a hierarchical structure (16). Evidence of these properties is shown in the interview material.

The immediate group goal, expressed by the workers, is to turn out good engines. When an engine performs satisfactorily during testing, it is a "good" engine and is "sold" to the

inspector. An engine which does not meet performance requirements is a "bad" engine, a "reject," and is sent to the penalty line in another department for repairs.

The general feeling is that time spent in testing an engine which has to be rejected is wasted, and nothing accomplished until the engine is sold. Of the men who discussed this question, only two said it made no difference to them whether it was sold or rejected. It is significant to note that these two, who did not accept this group goal, were among the lowest of the workers in sociometric status. One received no choice, and the other only one.

Typical of the workers' descriptions of their feelings about rejected engines are the following comments from their interviews:

"If there is any possible way to keep from rejecting one, we do, but we would rather reject one than to get a pilot over enemy territory without enough fuel. It is his life, and he is going to have to depend on us. It is added cost to the government when I have to reject one. I feel good when they are good engines. It's time wasted when they aren't; seems like we haven't accomplished much."

"On the work load a reject engine is considered a work unit and is considered in the work load. There's no pressure to get out good engines, but you don't feel as if you had accomplished much. It isn't the same to say, 'I got three engines' as it is to say 'I sold three engines.' Good engines mean you have good luck and you haven't the problems you would have had if they had been bad. If we can, we repair them right there. We try our best to fix it right there. Sometimes it takes considerable consultation."

"In selling the jet you are doing more for your country than if you were just doing a job for somebody else. You are doing good for the service boys. You are doing it for all of us. Maybe because the jets are ready to go out and do something. Maybe over here you feel the job is more complete."

Throughout these discussions a complex of integrated attitudes begins to make itself evident. Testing an engine is regarded as more than just a mechanical job; it is an accomplishment which is related to larger social values already incorporated within the individual by his society. "Selling an engine" means protecting a pilot's life, building a stronger air force, making a better country. These values are served in Engine Test through the common group effort. They add importance and meaning to the work. In the interview, if spontaneous reference to purpose were not made, the worker was asked: *What do you feel you are accomplishing with this job?* Following are some of the comments:

"Most of the boys get the over-all picture. Getting good engines, one after another, and seeing them going out to fly makes the morale go up."

"I feel like I'm helping the country. I've done something that will help us have a better place to live. By building a stronger air force. Somebody's got to do it, and I'm proud that I'm in the number. The younger generation will need a fitting place to live, and sometimes it don't look too favorable."

"When you get an engine out you feel you have accomplished something. Because you realize that when an engine gets into a plane, there are several lives that depend on the engine, and it gives you a feeling of satisfaction to know they can depend on it."

Group norms apparently center around behaviors concerned with the common, cooperative effort – accepting and discharging responsibility, willingness to help out, to teach others, doing *one's part*, *rotating* jobs, working out group decisions in production problems, and sharing the common interest in test performance. Adherence to these norms results in behaviors highly consistent with plant production and from which high morale is inferred.

It was noted in the sociogram analysis that patterns of leadership are not highly defined. This is an informal group in a highly organized institutional setting, where formal leadership is already established. When matters of unusual importance arise, requiring new decisions, these problems are taken to supervisors and foremen. The teamwork character of the work calls for a democratic rather than an authoritarian direction. Assignments are usually given to the workers in groups, and details of procedure are worked out among them. The workers describe it:

"They tell you what they want and leave you alone. If you have a problem you take it to them and they help you."

"My present supervisor is about as good as I have had. He tells us to do something in a

nice, respectable way. He says 'Boys, we've got a certain job we've got to do.' If we have trouble, whatever it is, it is our trouble and he will tell us to fix it."

Supervisors were most frequently described by the man as giving assignments, allowing the workers to proceed on their own initiative, and offering help readily when needed.

The quality of supervision did not appear to be a matter of much moment to the Engine Test employees. Sharp criticism came from only one worker, and enthusiastic comments from a few. In general, however, the attitude was favorable, with mild praise and mild criticism.

This type of democratic leadership and the accompanying emotional climate are reminiscent of group effects produced experimentally in the study of leadership by Lewin et al. (24). Introduced into adolescent craft groups were leaders who assumed *democratic*, *authoritarian*, and laissez-faire roles. The authoritarian leader initiated individual or group activity with an order and gave subjective criticisms. The democratic leader took less initiative, was more objective, and encouraged group activity, while the laissez-faire took no initiative, responding only when requested. The authoritarian leadership produced in the group either dependence, or frustration and aggression, channeled toward an outgroup and the leader. There were less aggression and more initiative in the democratically led group. When the leaders came late, the democratic group had proceeded with production; the authoritarian group did nothing, while the laissez-faire group was active but not productive.

Supervisory policies may have much to do with the initiative, responsibility-sharing, and emergence of group motivations found in the Engine Test workers.

To outward appearances, Engine Test is an undesirable place to work. There is the high noise intensity, and the job is dangerous, with the constant possibility of explosion or fire from the untested engines. Workers are exposed to outside temperatures, since the vented cells cannot be heated or air conditioned because of the rush of air set up by the running engines. The work is greasy. One worker who said he would not exchange his job for any other told of his feelings when he received a transfer to Engine Test: "When they told me I was going to the Test Block, I thought I would quit. That noisy, dirty place was the last place I wanted to go."

In view of the basic attitudes related by the workers toward their jobs, it is not surprising to find that the unpleasant aspects of their work are minimized. In the interviews, only a few mentioned spontaneously the noise. A larger number mentioned noise when asked what they did not like about their jobs, but with the majority, it was necessary to ask a specific question in order to elicit an expression of feeling about the high noise level. About half said the noise bothered them; the other half said it did not, but that it had bothered them at first. Along with noise, vibration was occasionally mentioned as an annoyance: "The first six weeks, I went home still shaking from the vibration. I thought I couldn't stand it. But I finally got over that and began to like it."

The length of time of adjustment to the noise, as reported by those who said the noise did not bother them, varied from "a day or two" to two years. One, who said the noise still bothers him, has been in the test block since 1945. Several who were counted in the group that found the noise bothersome, said they did not mind the noise, but they were afraid it was affecting their hearing. There was some complaint about the ear plugs. Several said they thought plastic ear plugs would be an improvement.[4] Some said the noise bothered them only when they were feeling bad or had a cold. The workers did not dwell on the subject of noise. Those who did not like it, did not make lengthy complaints or exhibit much feeling.

The two workers in the entire interviewed group, who discussed the noise with anything approaching vigor, were both welders who had been transferred to Engine Test less than three months before the interview. From the viewpoint of the effect of group identifications on attitudes toward the job, the reaction of these workers is significant. Said one: "I like to do welding best. That's my trade and I'm good at it. I don't like to work on the greasy, wet floor. I'm allergic to kerosene. The noise bothers me. I haven't but one good ear to start with. Sometimes I feel like I'm going to scream and run out of the

[4]The provision of individually fitted acrylic ear defenders to these workers was begun by the Occupational Health Service on 18 January 1955.

place. The old boys who have been here a long time, it doesn't seem to bother. It was probably what they wanted to do to start with."

This worker stated clearly his own ego-involvement in the welding trade, and recognized a relationship between the Engine Testers' interest in their job and their adjustment to the noise. But his identifications were different from theirs.

The effect of ego-attitudes upon the way a person perceives the situation in which he finds himself was suggested further by this worker's complaint that the job of engine testing was monotonous. This was in direct opposition to the unanimously expressed viewpoint of the other Engine Testers who described their jobs as interesting because of the variety: "It's never boresome because there's something new all the time. Every engine is different."

The attitudes of the second recently arrived Welder were similar to those of the first: "I like welding best. I'd be crazy to say the noise doesn't bother me. . . .In welding, there is a kindredship."

Engine Test workers made fewer references to exposure to the weather, than exposure to noise. Some mentioned fresh air as a reason for liking their jobs: "I like the Test Block because you're not cooped up in an air conditioned building. I like to be outside. You feel better because of the fresh air. I've had less sickness since I've been over here."

The strongest complaint was: "I don't like to get out in the weather. You catch cold and it isn't too comfortable."

One worker rationalized: "Good working conditions. You don't have to get out in the cold for very long at a time."

Another took comfort in his group relationships: "In the cold you can dress for it, and you know you'll be warm when you get back inside. When it's hot, everybody else is sweating, too."

In describing their jobs, the subjects occasionally told of the danger and need for caution, but nobody mentioned the hazard of engine explosion as an unfavorable aspect of his job. Two workers spoke of the danger as a reason for liking their jobs. One said: "It's exciting. You get a thrill out of it because it is dangerous."

Several referred to standing on slippery pipes as a safety hazard.

About one-fourth of those interviewed mentioned psychologically unfavorable aspects of their work. These included complaints about favoritism and inequities in giving raises, ratings, overtime, loan-out, and getting "bumped" (a demotion in grade – many of which had come about throughout the plant in a reduction in force and reorganization several months before the study). These complaints were on an individual basis, there being no unanimity of group criticism.

When complaints were made on these scores, the criticism was outspoken, and the subject elaborated upon it, but the general tenor was toward a philosophic acceptance of the evil.

In only one instance did a worker devote the major part of his discussion to criticism. This centered on his inability to get the raises for which he felt he was qualified, and which he felt were being kept from him unfairly. The criticism spread to the work methods of his supervisor, and he spoke of his difficulty in keeping the equipment in good order. He ended his remarks with the statement: "Working conditions are ideal. I love my work."

Spontaneous, but less lengthy criticism was offered by five more workers. Typical was the following: "I was Grade 15 and got bumped to Grade 10. Can't say that I liked it, but what can you do? I don't believe it is very fair. Seniority doesn't have any effect, but we have got to realize that G.I.'s should have privileges. But over the Field there are cases where the G.I.'s have taken the privilege when they weren't qualified. The Grade 10's have to teach the 15's how to operate. We have the best government in the world, but they don't want to hurt anyone. It's like all government jobs. It is whoever has the pull. It is a general thing. If it was run the way Civil Service and the government intended it to run, it would be the best place in the world."

In Engine Test, it was noted, the jobs of operator and recorder were differentiated technically and carried different grades, while in actual practice the work was interchanged. Several of the workers of both grades said they regarded this differential in salary for the same work as unfair, but they did not express it as a matter of paramount concern. This may be related to the sociometric finding that status in the test block was not dependent upon salary.

Most of the criticism from the workers was minor, and given in response to questions from the interviewer:

"The work is dirty, but I don't mind that. We haven't enough parts to go around, and sometimes you have to wait until the other guy gets through with it."

"Don't get my share of the overtime. Some get more and some less. All supervisors have their pick. But can't complain. I've done as good as the average."

"I don't like to change shifts, and there's no hot water in the rest rooms."

"The floors are rough, and it's hard to push the engines over them. But I guess it's that way all over."

Most of the criticism, freely expressed by the workers, was directed toward the jobs they held formerly in other parts of the field as they compared them unfavorably with their present job. They pointed out that on other jobs, they had worked on parts whose purpose they did not understand or which seemed unimportant to them. They contrasted the repetitiveness and monotony of previous jobs with the variety and interest they found in their current work. They liked their present supervision better, saying that in Engine Test the employee felt he was trusted more and was not subject to constant scrutiny. Nearly all spoke of the superior cooperation and friendliness of their present co-workers.

The group structure, the workers' identifications with it, and the consequent regulation of their behavior in accordance with group norms has been outlined. Throughout the discussion, some of the basic conditions which had brought about this situation have become evident. Some have not been so apparent.

One of the factors contributing to group consciousness might be the physical separation of Engine Test from the rest of the Field, marking it off as a distinct unit, and giving it an individuality of its own. Because they are spatially separated from other workers, Engine Test employees must interact among themselves. A second basic condition is the interdependent character of the work to be done. The job is not one which can be accomplished in isolation, but is dependent upon cooperative effort. There is the democratic supervisory policy, and a communality of knowledge about the job. Operators and recorders have had experience on the preparation line, and preparation line workers are acquainted with the purpose and function of the Engine Testers.

Another influence is the mobility of the recorders who divide their time between the two jobs and integrate social contact between operators and preparation line workers. Undoubtedly of importance, also, is the fact that, as a consequence of changes in the work load schedule which make varying demands upon the workers' time, two different lunch periods have been set up, and the lunch hours of the individual workers frequently are changed. This system tends to break up the habitual contacts which lead to tight cliques; it fosters continually renewed associations among the various group members.

Lastly, and of central importance to the problem, is the point that the purpose of all this functioning is tangible, concrete, and easily grasped. The completed engine is a visible accomplishment which is related directly to the individual's socially learned values. It is a reminder of his own contribution, and imparts a sense of his value in the scheme of things – a value which is dependent upon his occupational group membership.

XI. GROUP RELATIONS AMONG THE WELDERS

One important difference between welding and engine testing is that welding is a skill, which at one time in their history, the welders chose voluntarily – one in which they were employed before coming to Tinker Field, and which they might continue to practice should they leave. Many have taken special welding courses. Welders can invest in and own the equipment necessary to implement their trade, and many of those interviewed have done so. Thus, they are mobile, prepared to practice welding wherever they desire and opportunity affords. The engine testers were, on the other hand, transferred to their department not upon their own behest. Their job was accorded them; they learned the skill, and to like the work, at TAFB. Opportunities for work of the same nature elsewhere are extremely limited. Therefore, the primary involvements of the engine testers are bound up with Tinker Field. With the welders, this is not necessarily so.

The welder may work with a wide variety of products and industrial organizations. The

stable factor in his career is the weld itself, and it is in this that the welder takes pride. The object on which he places the weld is of little concern to him. He is creating a weld, not helping to manufacture an object, and he is not involved personally in the function or nature of the product.

"Show a welder an entire airplane," said one foreman, "and all he will see is the weld."

One welder explained: "I know what some of these parts I work on are, but there is a variety of them, and you haven't any idea what their purpose is. It would be interesting to know, but it brings you back to the age-old argument, a weld is either good or bad, no matter where you put it."

There is a personal quality to a weld. Welders insist they can always recognize their own welds, but they are uniformly vague as to how this is done. Trying to explain, one said: "Well, you can recognize your own sewing, can't you?"

Unlike the engine testers, the welders have not, therefore, become ego-involved in jet engines, nor are their job satisfactions anchored securely in the functions of TAFB. Primarily, they identify themselves as welders; only secondarily are they Tinker Field employees.

It does not follow from this alone that their involvements are less intense, or the gratifications of their work less satisfying. It does mean that there is a basic difference in motivation and that the conditions affecting morale among the welders will differ from those in Engine Test.

Various welders referred to their work as fascinating, spoke of its lack of monotony, expressed themselves as believing it required a higher degree of skill than the average trade, and admitted to having a definite pride in good work.

A second important aspect in which the work of the welders differs from that of the engine testers is its relatively isolated character. The welder is not only physically separated from others as he performs his job; the work is an entirely individual matter, accomplished independently of others. There is no cooperative effort to turn out a single product, no ready-made, shared goal which may be reached by common effort. These conditions would be expected to affect motivations and the nature of the group formation.

In figure 5 is the sociogram showing group structure of the welders, as derived from the criterion item in the sociometric questionnaire. The upper part of the sociogram depicts a tightly knit clique of eight members (Nos. 1 to 8). Two other welders, Nos. 15 and 17, make reciprocating choices with the other clique members, and properly belong with this group. Their apparent peripheral position is a consequence of special factors which influence the choice on the criterion question. One was "raised up against cards, so I just sit and watch the others," and the other left the group each noon to have lunch with his fiancee. Something of the strength of these associations is shown by the consistent presence of the double-headed arrows which indicate reciprocating choices. These are established and habitual associations, and they were found in the overwhelming majority of the choices made among the clique members. The clique is an exclusive one; the choice lines of the members were, for the most part, confined to themselves. Of the 35 choices made by these individuals, only three extended to non-clique welders.

The pattern of leadership is clearly defined. The clique divides itself into two sub-groups, represented by a cluster on either side of the central, leading individual. Each of the smaller groups has its dominant figure, and it is interesting that only one choice line goes directly from one of these sub-groups to the other (Nos. 4 to 7), and this choice is not reciprocated. It is through the strength of the leader, No. 5, who shows reciprocating choices in both sub-groups, that the clique is bound together.

Beyond the clique members, social expansiveness, as indicated by the number of choices made, drops sharply. Where the clique members made a total of 35 choices, non-clique welders made a total of 16. Six, or 37 percent, of these extended to clique members. Seventy-five percent of the non-clique welders were chosen only once or not at all, while none of the clique members received fewer than two choices.

As indicated by triangular arrangements in the lower part of the sociogram, the non-clique welders made some effort at sub-group formation, but these choices were not reciprocated and were loosely knit. While clique members made 13 reciprocating choices, only one such choice appeared among the non-clique welders. The

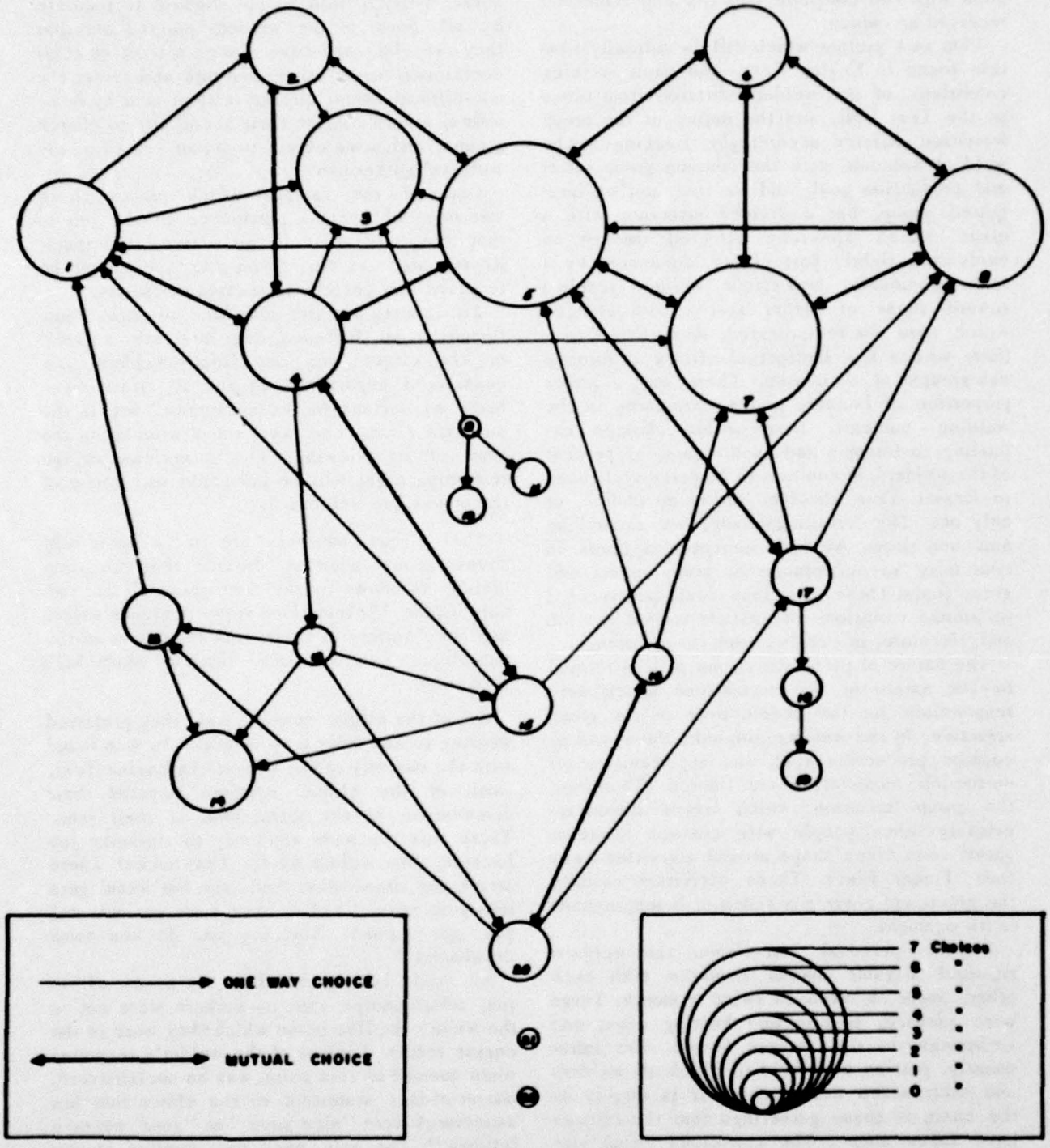

FIGURE 5

Selection of lunch and card game companions by workers in Welding Sub-unit.

structure trails off, thinning as it goes until it ends with two complete isolates who made and received no choice.

This is a picture which differs radically from that found in Engine Test. The basic working conditions of the welders differed from those in the Test Unit, and the nature of the group formation differed accordingly. Lacking in the welding sub-unit were the common group effort and production goal, and we find, not an integrated group, but a divided structure with a clear status hierarchy effected through an exclusive, tightly knit clique, dominated by a few individuals. Non-clique welders reached toward those of higher status with choices which were not reciprocated, or withdrew from them with a few ineffectual efforts at forming sub-groups of their own. There was a larger proportion of isolates and near-isolates in the welding sub-unit. Disregarding choices extending to foremen and supervisors, 37 percent of the welders, in contrast to 10 percent of those in Engine Test, received either no choice, or only one. The definite cleavage between clique and non-clique welders indicates a break in continuity in acceptance of group norms and group goals. These variations would be expected to arouse variations in attitude toward the job and, therefore, in morale among the welders.

The nature of these variations will be related to the nature of the motivations which were responsible for the development of the group structure. In the welding sub-unit, there was no common production goal, and opportunities for on-the-job association are limited. Therefore, the group formation, which arises almost inevitably when people with common interests gather, has taken shape around activities away from Tinker Field. These activities solidify the group and provide a sense of belongingness to its members.

In the personal interviews, the welders reported regular social contacts with each other, some as often as twice a month. There were picnics, fishing and hunting trips, and gatherings in the various homes. Not infrequently, parties were held to which all welders and their wives were invited. It is largely on the basis of these gatherings that the cliques have taken shape. The conscious intent was not to form exclusive groups, and some of the welders expressed concern that other co-workers did not attend their gatherings. But this group norm is not universally accepted; such active social participation is not viewed as feasible by all. Some of the welders pointed out that they are older and have placed a limit on their social activities; some commute and prefer the established social circles in their near-by home towns; others confine their social life to church groups, and some object to liquor served at the welders' gatherings.

One of the factors which makes these meetings of special pertinence to the job is that the supervisor is an active participant. Represented as No. 3 on the sociogram, he received four choices from clique members.

To investigate the influence of this group formation on attitudes, the interview material of the clique and non-clique welders was considered separately. Of the 10 clique members, as defined in the sociogram, one is the supervisor and one was not available at the time of interviewing. The interviews of the remaining eight will be compared with those of the non-clique welders.

The clique members are in a peculiarly advantageous position. Beside their in-group status, as shown by the sociogram, all but two hold Grade 15, and thus enjoy a higher salary and more variety in their work than most of the non-clique welders, only four of whom hold this grade.

All of the clique members said they preferred welding to any other type of work. As was found with the majority of the workers in Engine Test, most of the clique members devoted their discussions to the attractions of their jobs. There was the same tendency to minimize job hazards. One welder said: "Drawbacks? There aren't any drawbacks. Well, the hot metal gets into your eyes. I had to have some cut out, and you get burned. Anything you do has some drawbacks."

As would be expected from the nature of his job, relationships with co-workers were not to the welder the live issue which they were to the engine tester. Typical of the welder's response when queried on this point, was an unelaborated, matter-of-fact statement to the effect that his associates were "nice guys," or "good, average fellows." The only ones who dwelled at any length on these relationships were four of the clique members. The leader, No. 5, on the sociogram, commented: "The boys in the shop

are friendly. They all help you. It's a better-than-average shop. During lunch and smoke periods, we all go out together. During working hours, somebody asks me to get a welding rod or something. There is a lot of competition. We are all trying to outdo one another and get a lot of fun out of it. Probably get more work done that way. We haven't as much contact as some of the other shops, and this is good because they don't get old, and you don't get tired of them. We're always glad to see each other when we come out of the booth."

Another spoke of the competitive relationship, and evaluated his fellow workers: "Competition is keen which creates interest. Each welder takes pride in his work, and then you try to do a better grade of work. You know the other fellow is good, and you try to be as good or better..... They have nice personalities, are congenial. Morals are high. They are nice and clean. They are easy to get along with."

Three of the clique members described good supervision as a major reason for liking their jobs. Four spoke of variety of work as a job attraction. These welders described a sense of accomplishment and the high level of skill required by their work. They spoke favorably of the rotation system; one named clean working conditions, and another said he liked the sick leave. One said it was an easy way to earn a living, but none of the clique mentioned salary as a reason for liking his job.

Complaint was offered voluntarily by only one clique member, and when specifically asked for, criticism was minor. Asked about disadvantages of his work, one welder said the booths were too small and the ventilation bad; another mentioned "eyestrain" and fumes.

The clique welder who volunteered complaint discussed in detail a basic dissatisfaction which centered around feelings of uncertainty about the security of his position. He explained that during periods of slack work loads, rumors of a reduction in force were common over the plant. Selection of those to be discharged is based upon comparative retention points, and his chief complaint was his inability to find out where he stood on this scale.

Of the 12 welders represented on the sociogram as non-clique members, two are foremen. Of the remaining 10, four hold Grade 15, and six hold Grade 10. The Grade 10 Welders are engaged in a repetitive type of work. For the most part, these workers do heliarc welding on combustion chambers and their inner linings. Heliarc welding is a finer, more precise process than other types performed in the shop. It is more exacting and requires a high degree of steadiness and concentration. Several conditions, therefore, accrue to the disadvantage of these welders. Beside their relatively low status position, as shown on the sociogram, they have lower salaries, perform a repetitive type of work, and do not have the opportunity to handle different metals and learn a variety of welding processes, as do those classified as Grade 15.

In the personal interviews, six of the non-clique welders said they wanted to leave welding. Five of these said they preferred another kind of work, and one said welding strained his eyes. Four of these workers held Grade 10, and two held Grade 15.

While only one of the clique members offered criticism voluntarily, complaint was offered spontaneously by nine of the 10 non-clique welders. With five of these workers, complaints came out early in the interview, and occupied a major part of the discussion. These complaints projected the frustrations and insecurities felt by these workers as a consequence of their peripheral position in the group with which they would identify. They described a sense of isolation, of being dealt with arbitrarily, or of being disciminated against.

Within this psychologic milieu, unfavorable aspects of the job loom large. There was not the tendency to minimize job hazards and inconveniences—a tendency found in the clique members and engine testers. Nearly all of the non-clique group said welding was hard on their eyes. They described the work as strenuous, unhealthful, "nerve racking," and spoke of fatigue. They complained of the fumes, the air conditioning, difficulty in getting raises, low pay, and described a feeling of uneasiness when work was slack. The chief complaint, however, voiced by nine of these welders, was of partiality. This centered about the system of loan-outs.

Although attitudes toward loan-outs were found to vary among the groups interviewed, the general feeling toward them was unfavorable. Most of the workers identified with their own units, felt that they belonged to them, and did

not relish the unfamiliarity of new work and surroundings.

The non-clique welders expressed two specific complaints about loan-outs. One was that they were distributed unfairly, and the other was that they were loaned out to inferior positions.

The welder was ego-involved in his role as a welder, and, when it was taken from him, the reaction was emotionally charged: "Out here welding isn't a skill. They feel you aren't doing anything, and they pull you out and loan you out on anything they want to. They loan out a $2.95 man on a 95¢ job. They don't care about what you are doing when they loan you out anywhere."

Non-clique welders expressed their feelings in what they considered to be the unfairness of the loan-out system: "I don't mind being loaned out if it is my share. I don't like to be the last on the list when the good comes up and the first when something bad comes up."

The importance of the feeling about the loan-out, rather than the loan-out per se, was clearly explained by one welder: "To tell you the truth, that last loan-out was interesting. I was learning something new, and I would have volunteered for it. But I resented every minute of it because I'm the one who always gets sent, and it isn't fair."

The pronounced feelings of insecurity engendered during periods of slack loads described by one of the clique members, were frequently expressed by the non-clique group. According to the workers, the general plant policy of keeping busy during working hours applied whether they were given work to do or not. This posed a problem of having to look busy at times when they had no work to do. This, of course, involved subterfuge, and added a feeling of guilt to the anxiety already aroused about the security of their jobs.

It is evident that it is the uncertainty of the situation which makes it a threat to job security. In the absence of authoritative information, the workers can only guess what the slack periods presage. Rumors arise and anxiety increases. In the non-clique group these anxieties are common, because members of this group are already insecure in their peripheral group position. The slack work period was a matter of concern to only one of the clique members; the rest did not mention it.

Of the four non-clique welders who preferred welding to another trade, one named good supervision as a reason for liking his job. One welder in this group, in Grade 10, spoke of the work as "creative." One said he liked the work because it was clean, and he didn't have to climb, as he did in construction welding. Another named "working conditions, temperature, drinking water, lighting, rest room." All four named salary as a major attraction. All of the non-clique welders, including those who said they wanted to change jobs, spoke with enthusiasm about the welding operation itself.

These welders express their ego-involvement in the welding trade, and clearly identify themselves with this occupational group. Yet, their membership in the immediate group of welders with whom they would identify, is of marginal character. The effect of this situation on attitudes toward their present jobs is directly expressed in their complaints.

Lack of definite knowledge about organizational functioning was shown in the interviews of clique and non-clique welders alike. None was able to give a clear statement of his retention points. They did not know who was responsible for decisions about annual and sick leaves. They did not know what schedule was followed in the system of loan-outs, or who selected those to be sent. They did not know how overtime was distributed or who was responsible. They were not sure who made the final decisions on letters of recommendation for raises or the procedure for acceptance or rejection of suggestions for improvement of plant operations, which they were encouraged to send in. There was a uniform lack of understanding about the standards required of the worker for attainment of the Step 4 raise.

In this ambiguous situation, aggression of complaining non-clique welders was, in general, directed vaguely toward "them," a term which included the several levels of supervisory personnel – the supervisor, foreman, and general foreman.

With the clique members, the situation was changed. These welders expressed loyalty toward their supervisor, and their desire to be responsible to him. They wanted directives to come through him, and not directly from higher levels of authority. To him they brought all their problems.

This identification of the supervisor with the men under him may be related to several conditions. One is that the supervisory position is vertically mobile. Because of the system of retention points, supervisors are demoted not infrequently, or "bumped" back into the ranks. In every group interviewed were found workers who once had been supervisors. Occasionally, a worker will find himself supervising a former supervisor. This condition prevents the development of a caste relationship. Furthermore, there is but a small differential in salary. Those in Grade 15, Step 4, were receiving only nine cents per hour less than their supervisors. The authority of the supervisor was limited. In most cases, he could only pass requests for raises and other benefits on to his superior. This placed him in a position of seeking favors for his men from higher members of management, which served to define his interests more sharply with those of his workers.

The sociogram of the welders reflects this situation and its implications for their particular group. The supervisor, No. 3, received five choices; the foreman and general foreman, Nos. 10 and 11, received one choice each. These two choices were made by a welder, No. 9, who also chose his supervisor. He made no other choices and received none. One might speculate that, feeling isolated from his co-workers, this welder is reaching toward authority figures for support. None of the other welders, in either clique or non-clique group, chose anyone at a management level higher than his immediate supervisor. The sociogram depicts the labor-management dichotomy dividing at the foreman level. Another schism, that of clique and non-clique welders, is emphasized by the choices received by the supervisor. Four of the five choices which he received came from clique members.

The foremen, one or two steps removed from the worker, have the function of coordinating personnel on the one hand, with demands of a production schedule on the other. A frequently expressed desire of the foremen was for help in meeting these problems through supervisory training. This is a desire which was repeated by foremen in other units.

One said the training he had received at TAFB was helpful, but that he felt there was not enough of it: "You get these new ideas and go back and put them into practice for a while and then slip back into a rut. We need training courses more often if we are going to improve. I would like discussions with other supervisors, and see how they are handling their problems. We must have a lot of them in common."

Another said the same training was "too deep" for him and did not have enough practical application to the immediate problems.

Several foremen pointed out that their training was all along mechanical lines, and that they felt inadequately prepared in their job of understanding the problems of the men under them.

Apparently, one of the needs of this group, in both welders and supervisory personnel alike is for more information, clarification of plant policies and functions, and supervisory training. In the absence of objective information, judgments have been formed subjectively, and widely differing perceptions of the work and working conditions have been found to be associated with variations in the attitudes of the welders. These attitudes have been shown to be related to the worker's feeling of acceptance and belongingness and his group status.

XII. GROUP RELATIONS AMONG THE GRINDERS

Like the welders, most of the grinders worked alone, completing, independently of others, the operation on the engine part assigned to them. They worked in individual booths and wore protective eyewear. As it was with the engine testers, their work was assigned to them after they had come to TAFB, and they learned it on the job. Unlike the work of the other two groups, all of the grinding jobs were classified as repetitive. The work consisted entirely of a hand grinding operation on nozzle diaphrams, before and after welding. It was not necessary for the workmen to know the identity of the of the part on which they were working, or its function in the completed engine.

Lacking here were the conditions which, in the other units, were shown to be related to group formation and ego-involvements. The grinders had neither a chosen identification in a common, recognized craft as did the welders, nor the shared effort and production goal of the engine testers. The welders regarded the finished weld as an expression of their own chosen skill; the engine testers

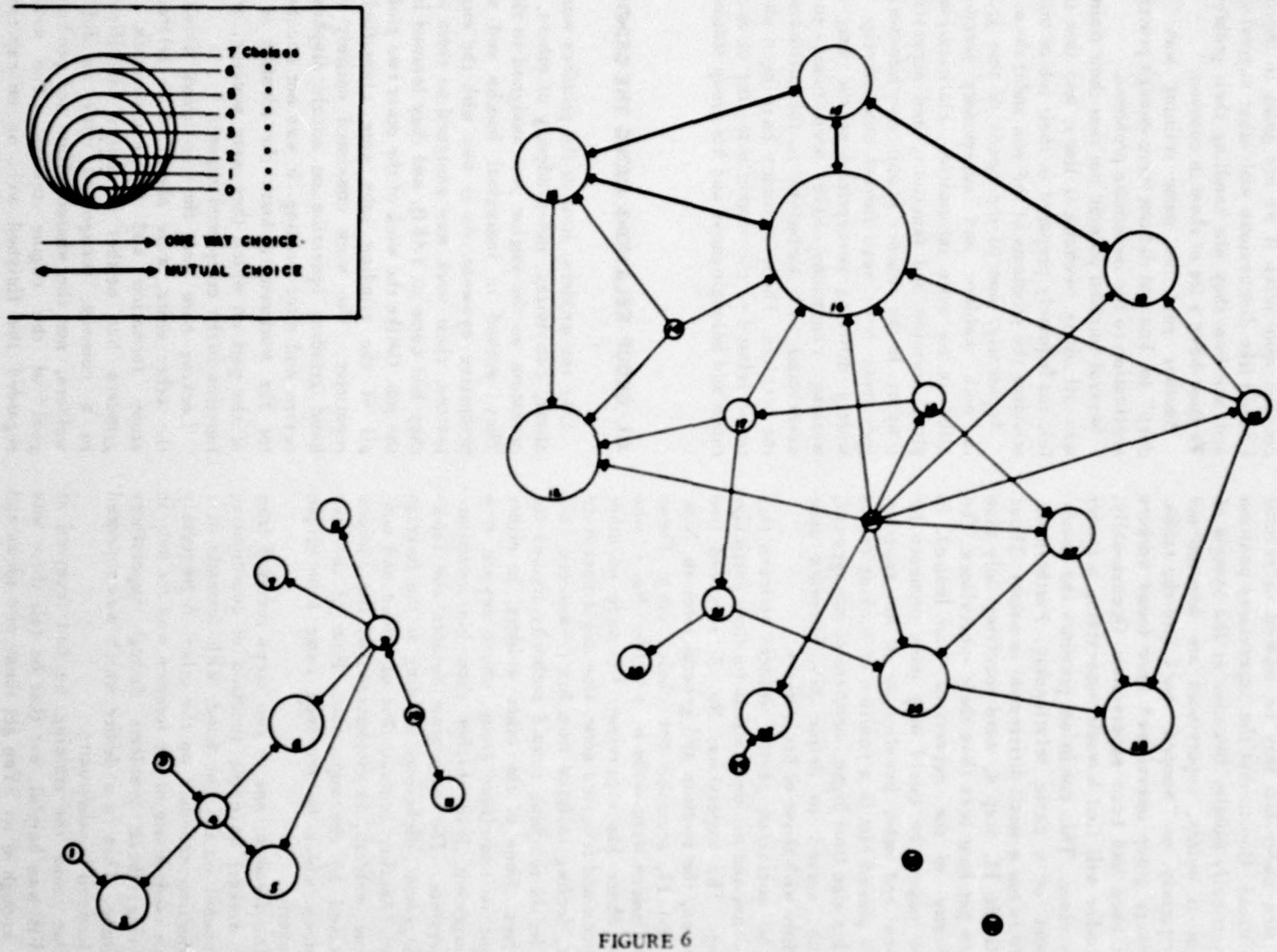

FIGURE 6

Selection of lunch and card game companions by grinders.

had the complete, functioning engine as a reminder of their accomplishment. For the grinders, the tangible goal of their labor did not extend beyond the immediate grinding of cracks, nicks, and burrs. While requiring a comparable degree of skill, the work did not offer the variety found in engine testing and many of the welding jobs. Apparently, here were no issues of interest to develop into the common motivations which serve as a basis for the emergence of group structure.

In figure 6 is presented the sociogram of the grinders, as shown by the criterion question. The immediately striking thing about this configuration, in comparison with the sociograms of the welders and engine testers, is the sparseness of the friendship choices. The connections are so tenuous that in one place they break entirely leaving two separate groupings. The 29 employees in the grinding sub-unit made an average of 1.55 choices each, as compared with the average of 3.00 of the engine testers, and the 2.70 average of the welders. The schism in the group appears not because of clique formation, but simply through lack of activity. In the entire group, there are only four reciprocating choices (Nos. 13 and 16, 13 and 15, 15 and 16, and 15 and 19) and only one clique, composed of three members (Nos. 13, 15, and 16). One of these members received seven choices. These choices apparently reflect his individual likeableness, rather than the exercise of leadership qualities, because he does little to weld the group together. No increase in group solidarity is evident in the interconnections of those who choose him. An opposite phenomenon is found in No. 22, who received no choice and made eight, as compared with the group average of 1.55. This worker was a newcomer. As yet not well established enough to receive any choice at all, he actively sought the companionship of his new acquaintances. His radiating choices give a spurious appearance of integration to the configuration.

The group is notable for its number of isolates and near-isolates. A large majority, 68 percent, received no more than one choice. Eight, or 28 percent of the group, received no choice at all (Nos. 1, 3, 10, 14, 22, 24, 29 and 30).

The structure bespeaks lack of group consciousness. This is not a group held together by forceful issues of mutual interest. One would not expect to find here the common enthusiasms and shared attitudes characteristic of more cohesive groups.

In the personal interviews, 17 of the 24 workers engaged in grinding said they preferred some other kind of work, and hoped for a transfer. The interview material of these 17 workers will be considered first. Recurring throughout their interviews was the feeling that they could not see what they were accomplishing, and did not feel the importance of their work – and therefore of themselves – in the Tinker scheme. One worker was explicit: "I would like to get into radio or automobile mechanics. I like handling machinery because it makes you feel like you are accomplishing something. I like to do something I can see when I'm through. Over here, it's them little, bitty old cracks, and you just grind them out. I've been doing it so long, and you get tired. It seems like it's all foolishness. You do it because the tech order says it should be done. I don't rightly know what the diaphram does, but I think it causes the turbine wheel to turn."

This feeling frequently was expressed indirectly, as the grinders described the jobs to which they wanted to transfer. One said: "I like electrical work on the aircraft line best. There they want you to make a modification. You tear out the old and put in the new and you feel like you have accomplished something. You feel like you was doing something that was real important. You are closer over there to the actual flight."

Apparently, these grinders found their job a repetitive, continuous process, unpunctuated by completed units of work which they could regard with satisfaction. Where the engine testers wanted "good" engines and felt that their time had been wasted when one had to be returned to the penalty line for adjustments, the grinders showed no such concern over the number of satisfactory nozzle diaphrams which they completed. "It doesn't make any difference what kind of a nozzle you work on. Doesn't matter if it has to have 40 or one blades. You have eight hours to put in, and I like to keep busy. Sometimes we put the bad nozzles in the booths of the lazy ones just to hear them rant and rave."

They spoke of their jobs as repetitious, and not calling for all their abilities. The grinders

who wanted to transfer complained that they were not learning anything new or gaining experience which would enable them to advance. To these grinders, the job holds few ramifications beyond the immediate grinding of cracks. They are working not on meaningful wholes, but on an isolated part of the engine (25), and only about one-fourth of them could give an accurate statement of where the part fits into the engine, or of its function. They expressed dissatisfaction with this lack of information and a desire to know more about their work: "I haven't had anything to do with a jet engine except this nozzle diaphram. It would be wonderful to know what we are working on. Wouldn't help to read it in a book. I want to see it."

These attitudes express a marked lack of ego-involvement in the work. These employees do not identify themselves as grinders of cracks, and no group formation develops on this basis. There is nothing of importance here to which they may belong. Their disinterest is reflected in the affectively neutral, matter-of-fact discussion of the good and bad points of their work. They spoke without the enthusiasms or lively resentments found in the other two groups.

Several expressed disappointment over not having received a Step 4 raise. Other criticism was minor and tempered. They mentioned the dust from the grinding machines, flying steel, "eyestrain," noise, lighting, and standing.

Asked what they liked about their work, the reaction of the 17 workers who wanted to leave grinding again was mild. Most of them expressed a liking for their supervisors.

Other mention of job attractions was meager Several spoke of the friendliness of their coworkers. Pointed out once in the total interviews of these workers were: pay every two weeks, individual tools and booth, clean work, it keeps you busy, and work can be done sitting down or standing up.

Of the 12 employees of the nozzle diaphram unit who said they preferred their present job to another, and wanted to stay, five were not grinders. One performed office work for the subunit; two were turret lathe operators, one was an instructor, and one was a helper. One of these said he liked his job because he liked the people he worked with; two liked it because it offered a chance of advancement.

One difference between the seven grinders who were satisfied with their jobs, and the rest of the group, was age. The average age of the seven satisfied workers was 48, while the average of the other workers was 31.

Five of those who liked the work were over 50, while none of the other group had reached that age.

Two of the grinders in their sixties said they liked the grinding job because it was easy. By easy, they meant that the job did not involve strong muscular effort. These workers spoke favorably of their supervisors and fellow workers.

As might be predicted, one of those who expressed interest in his job was Employee No. 16 on the sociogram. Recipient of seven choices, an outstanding number in this group, he showed the same capacity for minimizing job disadvantages as the clique welders and engine testers. The only one in the group who spoke favorably of working on an isolated part of the engine said: "It is interesting work. More interesting because you concentrate on one thing, and can do a better job where you are doing it all the time."

He said he would not transfer voluntarily, even for a Step raise, because he liked his supervisors and the people with whom he worked.

The youngest of the group of those who liked their job was 24. His only previous work was a painter, a job classified as repetitive. He had been promoted in his present unit from Grade 5 to Grade 10. He said he liked the work because it kept him busy.

Another, aged 44, said he liked his present job because he was accustomed to it. He described accurately the function of the nozzle diaphram in the engine, and was one of the few in the unit who expressed a feeling of accomplishment: "When you finish a diaphram, it is going back in the engine and will fly and do the job. I feel like you are getting something done every time a diaphram goes out. You know it is going back on a certain engine, and it is good, and I like to feel instrumental in saving somebody's life, peace or war."

Criticism in this group was not expressed spontaneously and when asked for was minor. They spoke of dust and noise with little complaint.

These workers expressed satisfaction in their personal relationships and in working

conditions, but showed little concern about the nature of the work itself. Older, with much of their career behind them, they felt little need of broadening their skills and mechanical experience. They expressed no desire for more satisfying occupational identifications, as did the younger workers. They appreciated the light work and enjoyed what personal contacts the job afforded.

None of the grinders complained about slack periods as did the welders, although these periods were comparable in the two groups. One grinder said he got the blues when he did not have enough work, but the rest did not express concern. Not valuing their work as do the welders, the grinders did not regard idle periods as representing so great a loss.

The grinders' lack of involvement in their work is evidenced, again, by their attitude toward loan-outs. The engine testers looked unfavorably on loan-outs because they did not want to be separated from their group, and the welders complained that during loan-outs they were not using their welding skills. None of the grinders complained about loan-outs, and most of them spoke with interest of their experience in other departments.

The disinterest expressed by the younger workers apparently centers around their inability to discover the purpose and usefulness of their efforts. They do not perceive the meaning of their own work as they compare it with other jobs around them which yield more tangible results. They do not see where their work and, therefore, they themselves fit into the picture. There is a consequent feeling of unimportance, of lack of belongingness in the total Tinker scheme. The job affords little ego-satisfaction or opportunity for development of secure satisfactory identifications.

This basic mood is demonstrated probably most revealingly in the attitude of the grinders toward the interview itself. In Engine Test, there was little evidence that the interviews held much personal import to the workers. They accepted the explanation that this was part of a study of plant conditions in which they were asked to cooperate, and they expressed willingness to help out. When thanked for cooperation at the close of the interview, the general response was to the effect that they were glad to do it and hoped they had been helpful. With the grinders, there was a complete reversal of attitude. They viewed the interviews as being helpful to them and expressed gratitude to the interviewer. In nearly every instance, they thanked the interviewer when the session came to a close.

XIII. JOB PERCEPTION AS A FUNCTION OF EGO-INVOLVEMENT

The study of attitudes through analysis of the way in which a person makes his judgments has become an important experimental approach to the problem of the motivations behind human behavior.

Entrenched attitudes, as well as transient emotional states inaccessible to direct study, may show clearly their presence in appropriate experimental settings where subjects are asked to give what appears to be purely intellectual estimates or judgments.

Perception of such explicit physical dimensions as weight (26), size (27, 28), color (29), geometric form (30), and quantity (31) have been shown experimentally to be influenced systematically by attitudinal factors.

This conceptual approach has been applied to the study of such complex areas as prejudice (32), group identifications (33), prestige factors (34), ego-involvements (35), and levels of aspiration (36, 37).

Level-of-aspiration experiments are concerned with a special case of judgmental activity, how a person sets his standards and goals. Whether they are high or low, realistic or unattainable, has been demonstrated to be dependent upon his ego-involvement and group status. In studies of this kind, subjects engage in a series of trials at a certain task and are asked to judge their scores as each trial is completed and to estimate their scores on the next trial. Sometimes subjects are run in pairs and are asked to make similar judgments of the performance of other subjects.

Experimenting in this manner, McGehee (38) found that the subjects' estimates of their own performances were consistently higher than their estimates of the future performances of others. Sherif (39) hypothesized that the differences in judgment which McGehee found were exclusive functions of differences in ego-involvements in the two types of situations. Affectively charged interest in their own

abilities changed qualitatively the judgments of the subjects when estimating their own performances. To test this hypothesis, she arranged an experiment in which a husband and a wife, or a parent and a child, estimated their own and each other's performances. It was assumed that in these positively involved pairs, each would be ego-involved in the performance of the other, as well as in his own. If this were the case, differences in judgment of one's own future performance and that of his partner would disappear. The results upheld her hypothesis, and she concluded that goal setting, or standard of performance, was a function of ego-involvement. Subsequent work (40, 41) has confirmed and expanded these formulations, and judgments involving standards and goals have been shown to be biased systematically by ego-involvements.

The Problem

In the present study, this conceptual approach was applied to the problem of worker morale at TAFB. The project sought to subject to test certain conclusions concerning morale drawn from the previous sociometric studies and personal interviews with industrial workers.

In the interview-study, an attempt was made to assess attitudes and feelings by encouraging the employees to talk about the various aspects of their work. A rigid interview schedule was not adhered to, and value was placed on the spontaneous expression of the workers.

The resulting qualitative data were interpreted from the theoretical viewpoint of ego-involvement psychology, with emphasis on group relationships. An ego-involved worker was defined as one who regards himself as a member of his trade, accepting his work as an expression of his own skills, abilities, and personal worth. It was concluded that certain differences in ego-involvements were associated with differences in those behaviors from which the degree of morale was inferred. Three separate groups of workers were interviewed – engine testers, welders, and grinders – and these groups were judged to differ in morale and ego-involvement factors.

On the basis of the experimentally established relationship between a person's ego-involvements and the way he sets his standards of performance, the present study hypothesizes that these groups will differ in standards related to their work.

This experiment was designed to test this hypothesis by asking the workers to make a series of judgments about abilities necessary to success in their jobs. Theoretically, the ego-involved worker who looks on his work as an expression of his own abilities, will feel that qualifications for success in his job are higher than will the worker who is not so involved. If high and low morale groups differ in ego-involvements, they should differ significantly in their judgments concerning job qualifications.

Experimental Design and Procedures

Subjects. Serving as subjects in the study were 105 TAFB workers representing three groups and divided as follows: 62 engine testers, 18 welders, and 25 grinders. All of the welders and grinders, and 50 engine testers had been seen for personal interviews, and on the basis of these interviews, the engine testers were judged to have high morale. There was found in the welding group a tight clique of nine members judged to have high morale. Morale was found to be low in the non-clique welders, and the grinders were judged to be low in morale. The groups differed further among and within themselves in three other dimensions – salary, skill, and degree of repetitiveness of work – as rated by a Tinker Field job analyst. These are shown in table VI where workers are classified by grade. Salary is determined by grade, and grade is determined by the skill required for the job. The average salary for Grade 10 is $3,785.60 per annum, while for Grade 15, it is $4,243.20.

Procedure. Subjects were assembled in groups and administered a specially devised scale, referred to as the E-Scale. Instructions, which appeared on each copy of the mimeographed scale, were read and questions answered.

The E-Scale. The scale consisted of 25 statements describing hypothetic workers of varying abilities. The subjects were asked to judge how successful each of the hypothetic workers would be in his own job by assigning to each, one of five ratings. Instructions were:

> What, in your opinion, are the abilities which make for success in your work? You be the judge and rate the men described below on how successful you think they would be in your own job. Consider for each one only the ability described. Rate each man 1, 2, 3, 4, or 5, according to the following key:

1. Excellent, the best.
2. Better than average.
3. As good as the average.
4. Rather poor, but could probably stay on the job.
5. Should not be hired for a job like mine.

The statements in the scale were developed around five popularly conceived, socially desirable "traits": responsibility, initiative, judgment, independence, and intelligence. Five statements were made about each trait, describing five different hypothetic workers who possessed the trait in different degrees. (See appendix B.)

Statements on the mimeographed scale presented to the subjects were in randomized order, according to Tippett's table of random numbers (42).

The rationale of the E-Scale is concerned with job standards, which are theoretically a function of ego-involvements. If a worker feels that his job calls for special abilities which he possesses, and in which he takes pride, he will be selective in the type of person whom he would judge to be capable of achieving equal success. If, however, he has little at stake psychologically if he is "just hiring out," as one worker put it, he would view his job as something which could be executed successfully by an average or even inferior worker. Accordingly, it was hypothesized that ego-involved workers would give lower ratings, as represented by the larger numbers, than noninvolved workers.

As a pilot study, the E-Scale, with minor revisions appropriate to the situation, was administered to 53 nurses at the University Hospitals (University of Oklahoma, Oklahoma City). The nurses were divided into high and low morale groups on the basis of the judgment of the Director of Nursing Services. The scale distinguished between the two groups above the 1 percent level of confidence ($t = 3.54$,) with the difference in the direction of greater selectivity by the high morale group.

Treatment of results. The average rating on each question was computed for each of the groups. Differences between these averages were evaluated by application of the t-test of significence of paired score differences (43). Significance was defined at the 5 percent confidence level.

The specific hypotheses to be tested were:

1. The E-Scale ratings of the engine testers and the welders will be significantly lower than those of the grinders.

2. The E-Scale ratings of clique welders will be significantly lower than ratings of non-clique welders.

Results

Comparisons of E-Scale ratings made by engine testers and welders with those made by grinders are presented in table VII. These figures show that ratings of engine testers and welders fall significantly below the ratings of the grinders. Since the grinders all hold Grade 10, an exclusive comparison was made of Grade 10 workers in the three groups. These comparisons also show significant differences. These are differences which would be expected to arise by chance alone less than 1 percent of the time, and they indicate that engine testers and welders are more selective than grinders in their judgments of the abilities required for success in their own jobs. These findings uphold hypothesis 1.

In table VIII are presented the E-Scale ratings of the welders divided into groups on the basis of their participation in clique membership, and also on the basis of grade. Comparison of clique and non-clique welders shows a difference in E-Scale ratings which is significant at the 5 percent level of confidence. The difference is toward greater selectivity in judgments of job qualifications by the clique members. These data are consistent with Hypothesis 2.

TABLE VI

Classification of subjects by grade and types of work

	Repetitive	Average	Diversified
Grade 10:			
Engine Testers	0	20	23
Welders	7	0	0
Grinders	25	0	0
Grade 15:			
Engine Testers	0	0	19
Welders	0	0	11
Grinders	0	0	0

Among the nine clique welders are seven in Grade 15 and two in Grade 10. The non-clique welders include four of Grade 15 and five of Grade 10. Divided on the basis of grade, the welders fall into two groups which are distinguished not only by a salary differential, but also by extremes of differences in type of job as described by the repetitive-diversified continuum (table VI). The work is also differentiated by degree of skill involved. Comparison of welders divided by these criteria (table VIII) shows no significant difference in E-Scale ratings.

Among the sub-groups of engine testers are found also differences in salary, required degree of skill, and diversification of duties (table VI). Further, the engine testers are divided physically into two separate groups, each in a different area on the Base. To assess the possible influence of these factors on E-Scale ratings, inter-area and intra-area comparisons were made among the various operators, recorders, and preparation line workers. These are shown in table IX.

Inspection of these data shows no significant difference in E-Scale ratings of operators, recorders, and preparation line workers. It is interesting to note that the largest difference found in these groups is between operators and recorders in Area Y, with the direction of the difference in favor of higher selectivity by the recorders who are in Grade 10 with a lower salary than the operators. This is a difference which would have arisen by chance factors 10 percent of the time, so it might be a chance finding or it could represent a trend.

None of the other differences begins to approach significance. Apparently, differences

TABLE VII

Comparison of differences in E-Scale ratings made by engine testers and welders with ratings made by grinders

	Mean difference	Standard error of difference	t	df	Significance (%)
Total Engine testers - Grinders	.084	.031	2.70	24	1
Total Welders - Grinders	.172	.046	3.72	24	1
Grade 10 Engine Testers - Grinders	.054	.0216	2.50	24	1
Grade 10 Welders - Grinders	.15	.0545	2.74	24	1

TABLE VIII

Comparisons of differences in E-Scale ratings made by subgroups among welders

	Mean difference	Standard error of difference	t	df	Significance
Clique Welders - Non-clique Welders	.150	.0729	2.06	24	5%
Grade 15 Welders - Grade 10 Welders	.032	.0519	.63	24	NS

in salary rate, required skill, or in work classified as average or diversified on the repetitive-diversified dimension, are not prime factors associated with ego-involvements as measured by the E-Scale in these groups. There are no significant differences between the ratings of comparable groups in Area X and Area Y. Judgments involving job standards made by the two different groups of workers, physically separated and with little interaction among them, but engaged in the same tasks, are shown to be comparable in this setting.

In table X are shown differences in E-Scale ratings made by engine testers and welders, classified by grade. These figures show no significant difference in ratings made by Grade 10 welders and Grade 10 engine testers. Ratings of the Grade 15 welders, however, are significantly higher than ratings of the Grade 15 engine testers, and this difference is significant at the one percent confidence level. The Grade 15 welders are more highly selective in their judgments of job qualifications than any of the other groups.

In addition to upholding the two experimental hypotheses, these analyses of the data show the following results:

There are no significant differences among the engine testers in E-Scale ratings.

The welders do not differ significantly when classified by grade.

Grade 10 welders and Grade 10 engine testers do not differ significantly.

Grade 15 welders differ significantly from Grade 15 engine testers, and the direction of

TABLE IX

Comparisons of E-Scale ratings made by subgroups among engine testers

	Mean difference	Standard error of difference	t	df	Significance
AREA X					
Recorders - Operators	0	.0571	0		NS
Recorders - Preparation Line	.013	.0627	.20		NS
Operators - Preparation Line	.024	.0515	.48		NS
AREA Y					
Recorders - Operators	.114	.0671	1.70	24	10%
Recorders - Preparation Line	.101	.0674	1.50	24	NS
Operators - Preparation Line	.013	.052	.25	24	NS
AREA X vs AREA Y					
Area X Operators - Area Y Operators	.017	.0639	.20	24	NS
Area Y Recorders - Area X Recorders	.039	.0640	.61	24	NS
Area X Preparation Line - Area Y Preparation Line	.042	.0696	.61	24	NS

the difference is toward greater ego-involvement of the Grade 15 welders as measured by the E-Scale.

Discussion

The significance of this study lies in its demonstration of the influence of motivational factors on judgment in a practical situation. Jobs rated by personnel workers through job analysis as requiring a comparable degree of skill were judged by the workers to require much or little ability, in accordance with their own feelings of morale. Thus, the Grade 10 grinders felt their work required significantly less ability than did Grade 10 welders and engine testers. On the other hand, when morale was uniformly high among workers in jobs rated through job analysis to require varying degrees of skill, there was no difference among the workers in their judgment of the degree of ability required by their work. This was demonstrated in the homogeneity of judgments made by the Grade 15 operators and Grade 10 recorders whose work was rated as diversified, and the Grade 10 preparation line workers whose work was rated as less varied.

The welders present a case of special interest. When interviewed, all the welders in both high and low morale groups alike expressed keen pride in their craft and enjoyment in the work itself. These are apparently the feelings reflected in the finding that Grade 15 and Grade 10 welders do not differ in job standards as measured by the E-Scale, and that even the low morale welders do not differ in E-Scale ratings from the high morale engine testers.

The differences in morale among welders are a consequence of another factor, that of clique membership. In interviews, the non-clique members were outspoken in their charges of partiality and in descriptions of their feelings of frustration growing out of their peripheral membership position in their group of co-workers. Half of them wanted to transfer to another department. Their E-Scale ratings differ significantly from those of the clique members. They do not feel that their jobs require the same high degree of ability that the clique members do. Their low status position has subtly affected their perception of job standards, and they fall below those of the high morale group.

These findings, showing the effects of attitudes on perception, throw some light on the consistent tendencies found in the interviews of high morale groups to minimize disagreeable aspects of their jobs, while low morale groups exaggerated them. The engine testers, describing with enthusiasm their feelings of accomplishment and their enjoyment in the teamwork relationships of their jobs, made little complaint about the high noise intensity occasioned by the running jet engines, their exposure to heat and cold in the vented cells where the engines were tested, the danger of fire or explosion from the untested engines, or the fact that their work inevitably is greasy.

The clique welders, eager to describe their fascination in their work and their harmonious relationships with supervisors and fellow workers, dismissed as routine the flying bits of hot slag or metal which burned them and occasionally had to be removed from their eyes.

The non-clique welders dwelled upon the usual strain, the fumes, fatigue, low pay, and

TABLE X

Comparisons of E-Scale ratings made by engine testers and welders classified by grade

	Mean difference	Standard error of difference	t	df	Significance
Grade 15 Welders - Operators	.1468	.0539	3.12	24	1%
Grade 10 Welders - Grade 10 Engine Testers	.0760	.0523	1.45	24	NS

described the work as strenuous and unhealthful. The grinders, few of whom understood the purpose of their work, and most of whom looked forward to a transfer to another job, showed little ego-involvement. They expressed little enthusiasm or hostility, and discussed the advantages and disadvantages of their jobs in a passive, matter-of-fact fashion. Their job standards, as measured by the E-Scale, were comparatively low.

These findings may be interpreted from the experimentally demonstrated viewpoint that perception varies in accordance with attitudes. Descriptions of working conditions made by these employees represent actual perceptions of their work, influenced in part by motivational factors.

XIV. CLINICAL DATA

Measures of effectiveness of a personnel group ordinarily are seen in rates of attendance or absenteeism, number or rate of visits to plant dispensaries, rate of turnover, and frequency and severity of injuries. Some of these measures were employed in comparing the Study Group with the Control Group and, in addition, certain historical data were isolated and compared, such as place of major residence, duration of education, and prior occupation.

The following information was obtained for each of the engine testers and the workers from the Parts Overhaul Section:

Total number of absences. Only absences resulting from *illness* or *injury* were recorded. A cut-off point was established for the completion of absence data so that the numerical values could be fixed in time.

Total number of days lost.

Total person-years of service (length of employment in present position).

From these totals, the following rates were determined:

Absence frequency rate - annual average number of absences per worker.

Absence disability rate - annual average number of days absent per worker.

Absence severity rate - average number of days absent per absence.

Dispensary visit rate - annual average number of dispensary visits per worker.

Additional background data consisted of:

Place of major residence-

North East: New England states together with New York, Pennsylvania, New Jersey, and Delaware.

South East: District of Columbia, Maryland, Virginia, West Virginia, Kentucky, Tennessee, North Carolina, and South Carolina.

North Central: Ohio, Indiana, Illinois, Michigan, Iowa, Minnesota, and Wisconsin.

South: Florida, Georgia, Alabama, Mississippi, and Louisiana.

Plains: North Dakota, South Dakota, Nebraska, Kansas.

South Central: Arkansas, Missouri, Oklahoma, Texas, New Mexico, and Arizona.

Mountain: Montana, Idaho, Wyoming, Colorado and Utah.

West: Washington, Oregon, California, and Nevada.

Duration of education - total number of years of schooling completed.

Prior major occupation. The following gross occupational groupings were utilized: Administrative and clerical; technical and scientific; crafts; protective and service; maintenance; laborer, including farming; equipment operator - fixed; equipment operator - mobile; sales workers; armed services; and unemployed or student.

Hourly pay rate -

Age.

Race: White and Negro.

In addition to the elements listed, the following were recorded for current and future correlations:

Number of dispensary visits for occupational illness.

Number of dispensary visits for occupational injury.

Number of dispensary visits for nonoccupational illness.

Number of dispensary visits for nonoccupational injury.

Number of dispensary revisits for occupational illness or injury.

Number of dispensary revisits for nonoccupational illness or injury.

Number of dispensary visits for industrial hygiene examinations.

Number of dispensary visits for other reasons.

The classification used of illness and injury was by these 24 classes:

Class 1. Infective and parasitic diseases (except certain acute respiratory infections and rheumatic fever).

a. Tuberculosis.
b. Venereal disease.
c. Infections commonly arising in the digestive tract.
d. Other bacterial diseases.
e. Spirochetal diseases (except syphilis).
f. Diseases attributable to viruses.
g. Rickettsial diseases.
h. Malaria.
i. Other infectious and parasitic diseases.

2. Neoplastic diseases.
   a. Malignant neoplasms.
   b. Neoplastic conditions of lymphoid and hematopoietic tissues.
   c. Benign neoplasms.
3. Allergic, endocrine system, metabolic, and nutritional diseases.
   a. Allergic disorders.
   b. Diseases of endocrine glands.
   c. Metabolic disorders (including avitaminoses).
4. Diseases of the blood and blood-forming organs.
5. Mental, psychoneurotic, and personality disorders.
   a. Psychotic disorders.
   b. Psychiatric disorders with demonstrable physical etiology or associated structural changes in the brain.
   c. Psychoneurotic disorders.
   d. Character and behavior disorders.
   e. Disorders of intelligence.
   f. Transient personality disorders due to acute or special stress.
6. Diseases of the nervous system.
7. Diseases of the eye and adnexa.
8. Diseases of the ear, nose, and throat.
9. Acute respiratory infections.
10. Other diseases of the respiratory system.
11. Diseases of the circulatory system.
   a. Rheumatic fever.
   b. Chronic rheumatic heart disease.
   c. Other heart disease.
   d. Other diseases of the circulatory system.
12. Dental diseases and conditions.
13. Diseases of the digestive system, and hernia.
14. Diseases of the urinary system and male genital system.
15. Diseases of the breast and female genital organs.
16. Deliveries and complications of pregnancy, childbirth, and the puerperium. Maternity furlough only.
17. Diseases of the skin and cellular tissues.
18. Diseases of the bones and organs of movement.
19. Congenital malformations.
20. Certain conditions of early infancy.
21. Symptoms and ill-defined conditions.
22. Special admissions.
23. Accidents (including industrial injury), violence, and poisonings.
   a. Injuries.
   b. Poisonings.
   c. Prophylactic reactions and therapeutic misadventures.
24. Other admissions without disease – doctor and dentist.

Clinical correlations. The absence and dispensary visit rates for the two groups appear in tables XI, XII, and XIII. Differences were evaluated by the t-test for the significance of the difference in means (106). A probability of .05 or less, that an observed difference was due to chance variation, was taken to indicate statistical significance.

The data used in all tables, except tables XIV, and XV, were obtained from rates computed for individuals.

In table XII appears a comparison of rates for the two groups. Of the four factors studied – absence frequency rate, absence disability rate, absence severity rate, and dispensary visit rate – statistically significant differences were found in the first two only: the Study Group as a whole demonstrated a significantly lower absence frequency rate, as did the Negro portion of the Study Group. The total group had a significantly lower absence disability rate than did the controls, and the white segment of the

TABLE XI

Means and standard deviations of absence frequency, absence disability, absence severity, and dispensary visit rates among study and control groups, by race.

Group	Number of persons	Absence frequency rate		Absence disability rate		Absence severity rate		Dispensary visit rate	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Study group									
Total	103	2.70	2.10	5.12	4.06	2.22	2.13	4.22	3.46
White	88	2.75	2.19	4.72	3.65	1.98	1.77	4.07	3.58
Negro	15	2.43	1.39	7.50	5.28	3.63	3.24	5.10	2.45
Control group									
Total	104	3.34	1.95	6.83	6.57	2.22	1.44	4.49	3.10
White	95	3.28	1.96	6.91	6.78	2.26	1.48	4.51	3.16
Negro	9	3.94	1.71	6.72	3.85	1.83	0.67	4.28	2.39

Study Group had a comparable lower rate. In other words, the engine testers had fewer absences per worker each year than did the welders and grinders – they reported for work more consistently. The Negro members of the same group did likewise, which suggests that there must be a contagious sharing of the morale felt by the engine testers, despite the lower level work assignments of the group's Negro employees. As occasionally nonwhite absences exceed those of white workers, and large numbers of colored employees may mean an increase of premium in industrial group policies, this work relationship has a good effect, and there must be a group-wide identification with the finished product – the jet engine ready for "sale."

The measurements of the absence disability rates show that the engine testers – the group as a whole, and its white members as a segment – had fewer days absent per worker than the welders and grinders.

TABLE XII

Comparison of study and control group means within race groups

Groups compared	Difference of group means*				Difference of means in terms of standard deviation of difference**				Probability of deviation this great occurring if compared groups were from same population			
	F	D	S	DV	F	D	S	DV	F	D	S	DV
Total	-0.64	-1.71	0.00	-0.27	-2.28	-2.26	0.00	-0.59	**0.023**	**0.024**	--	0.56
White	-0.53	-2.19	-0.28	-0.44	-1.71	-2.75	-1.16	-0.88	0.087	**0.006**	0.25	0.38
Negro	-1.51	0.78	1.80	0.82	-2.26	0.37	1.575	0.77	**0.034**	0.72	0.13	0.45

F - Absence frequency rate.
D - Absence disability rate.
S - Absence severity rate.
DV - Dispensary visit rate.
*Mean of study group minus mean of control group.
**Student's t for Negro groups.

TABLE XIII

Comparison of white and negro group means within study and control groups

	F		D		S		DV	
	Study	Control	Study	Control	Study	Control	Study	Control
Difference of group means (white mean less Negro mean)	0.32	-0.66	-2.78	0.19	-1.65	0.43	-1.03	0.23
Difference in units of standard deviation of difference	0.75	-1.09	-1.96	0.13	-1.92	1.59	-1.40	0.27
Probability of deviation this great occurring if compared groups were from same population	0.45	0.28	**0.050**	0.90	**0.055**	0.11	0.16	0.79

F - Absence frequency rate
D - Absence disability rate.
S - Absence severity rate.
DV - Dispensary visit rate.

In comparing workers within the groups (table XIII), it is seen that the white members of the Study Group had a significantly lower absence disability rate than did the colored workers. There was but a borderline significance in the absence severity rate for the white portion of the Study Group—findings somewhat more consistent with industrial experience.

The dispensary visit rates are shown for each group in table XIV; they are classified by reasons for visits, and the total visits were related to person-years of service for each group. Dispensary visit rates by reason for visit were not tabulated in detail sufficient to test the differences by the "difference between two means" technique.

However, a review of the figures will show: a negligible amount of occupational illness for both groups, an almost equal occupational injury rate for Study and Control Groups; and

TABLE XIV

Classification of dispensary visit rates

Group	Person years of service	Total visits	Reason for visit							
			Occupational		Nonoccupational		Occupational injury and illness	Nonoccupational injury and illness	Industrial hygiene examinations	Other
			Illness	Injury	Illness	Injury				
Study group										
Total	653.9	4.17	0.01	0.93	0.81	0.13	1.24	0.04	0.92	0.10
White	592.3	4.17	0.01	0.90	0.83	0.13	1.24	0.04	0.85	0.09
Negro	61.6	4.98	0.02	1.17	0.63	0.16	1.28	0.02	1.54	0.16
Control group										
Total	586.8	4.62	0.07	0.92	1.63	0.20	1.32	0.06	0.31	0.07
White	542.5	4.74	0.07	0.96	1.66	0.21	1.39	0.06	0.31	0.07
Negro	44.3	2.57	0.02	0.41	1.22	0.11	0.50	0.02	0.23	0.07

TABLE XV

Absence frequency, absence disability, and absence severity rates for absences attributed to occupational illness and occupational injury, by group, by race

Group	Person years of observation	Occupational illness			Occupational injury		
		F	D	S	F	D	S
Study group							
Total	653.9	.049	.139	2.84	.047	.139	2.94
White	592.3	.054	.154	2.84	.049	.149	3.03
Negro	61.6	.000	.000	0.00	.032	.049	1.50
Control group							
Total	586.8	.017	.043	2.50	.058	.314	5.41
White	542.5	.018	.046	2.50	.063	.339	5.41
Negro	44.3	.000	.000	0.00	.000	.000	0.00

F - Frequency.
D - Disability.
S - Severity.

a dispensary visit rate for nonoccupational illness for the welders and grinders of twice that for the engine testers. Visits made for "industrial hygiene examinations" are dictated by the exposure to hazardous work materials and do not represent self-motivated visits. The Study Group, because of work in a noisy environment, had a greater number of such examinations – in this instance, audiometric studies.

In table XV absence rates are shown by group and by race as attributed to occupational injury. Here, also, absence rates for individuals for these classified reasons for absence were not available in sufficient detail to test the statistical significance of differences. Nevertheless, absence and days absent data were used with person-years of service for each group to compute rates.

On reviewing this table, one sees higher rates for occupational illness – caused absence in the Study Group than in the Control Group, particularly in the absence disability rate.

The welders and grinders were higher, however, in absence disability and severity rates of absence attributed to occupational injury.

Background data. In further effort to measure any differences between the two groups under scrutiny that might explain a contrasting morale pattern, certain background factors were evaluated.

Prior occupation. Because of a certain paucity in number of workers coming from prior occupational categories, some had to be grouped before evaluation, as seen in table XVI.

By the chi-square method of analysis, the variation between the groups with respect to prior occupations was found not to be statistically significant. It is of interest, however, to learn that the majority of the engine testers came from a laboring or farming background, and from crafts, second in number. The Control Group demonstrated the same order. Almost three-quarters of both groups stemmed from a manual labor type of job – at variance with the

TABLE XVI

Prior occupations of study and control groups

Prior occupation	Study		Control	
	Number	Percent	Number	Percent
Administrative and clerical, technical and scientific, sales workers	4	3.9	8	7.7
Crafts	23	22.3	29	27.9
Protective and service, maintenance, unemployed or student	4	3.9	9	8.7
Laborer including farming	53	51.5	47	45.2
Equipment operator fixed, equipment operator mobile	8	7.8	5	4.8
Armed services	11	10.7	6	5.8
Total	103	100.1	104	100.1

idea expressed in part II,[5] that the men trained for engine testing were recruited from the automobile and heavy machinery industries.

Major residence. Included for exploration was area of major residence, to determine if there might be a factor here causally related to morale. Again, because of sparseness in numbers, groupings of the major residence area categories were necessary (table XVII).

As above, by chi-square method of analysis, there was no significant difference statistically between the two groups with respect to residence before employment at TAFB. The table demonstrates rather well that the working groups were fairly homogeneous in their geographic origins. Veritably, the jet engines were "tested in Oklahoma by Oklahomans."

[5]As expressed in the official history of TAFB.

Years of schooling. Perhaps a reason for the difference in morale might be identified in a difference in educational attainment between the control employees and those in the Engine Test Section. Table XVIII depicts the schooling.

However, after analysis of the chi-square method, the variation between the groups with respect to years of schooling was found not to be statistically significant. The mean years of schooling in the Study Group was 10.1 years, while that in the Control Group was 9.9. Analyzing the difference between these means showed no statistically significant difference.

Years of service. The mean years of service in the Study Group was 6.31, and that in the Control Group, 5.65. Through analysis of the difference between these means, no statistically significant difference was found.

TABLE XVII

Area of major residence of study and control groups

Residence area	Study		Control	
	Number	Percent	Number	Percent
Northeast, North Central	4	3.9	9	8.7
South Central	93	90.3	88	84.6
Southeast, South, Plains, Mountain States, West	6	5.8	7	6.7
Total	103	100.0	104	100.0

TABLE XVIII

Years of schooling of study and control groups

Highest grade completed	Study		Control	
	Number	Percent	Number	Percent
0 - 8 (grade school)	42	41.2	50	48.5
9 - 12 (high school)	48	47.1	44	42.7
1 - 4 (college)	12	11.8	9	8.7
Total	102*	100.1	103	99.9

*One unknown excluded.

XV. DISCUSSION

Throughout these studies, emphasis has been placed on the worker's perception of his job and his relationship to it. The practical value of such an approach lies in the fact that behavior is contingent upon perception. It would be expected that the effectiveness of the worker who perceives his job as requiring a high degree of skill would be greater than that of a wo.ker who sees his job as an unimportant one requiring little ability.

The problem resolves itself into one of perception which, in psychologic terms, is a complex reaction in which are integrated all the factors, internal and external, which are operative at a given time (16). In the present problem, external factors refer to the worker's physical environment, his co-workers and supervisors, and the work itself. Internal factors refer to individual personality variables and related work experiences which determine the way in which he perceives his job. To avoid bias, both sets of factors must be taken into account.

It is the operation of internal factors which makes perception a complex phenomenon which varies from perceiver to perceiver, and in the same perceiver at different times. Thus, many engine testers described their disturbance following encounter with the high noise level in the test block, and their subsequent indifference to it as they became acquainted with the work and learned to like it. The noise level remained the same; the adjustment of the workers changed, and with it came a change in perception of the noise. Different welders described the same work as monotonous or varied; grinders reported the same jobs as interesting or boring. Engine testers working in extreme heat and cold said they liked being out of doors, while grinders complained about being "cooped up in an old air-conditioned building." Workers differed significantly in their judgment of the degree of skill required by work rated by job analysis to require a comparable degree of skill.

These findings do not mean that working conditions are negligible factors which may be ignored. They do suggest that working conditions, per se, including noise, are not influential in producing morale or lack of it. The important factor is how the worker perceives the conditions under which he works.

The historical survey of representative writings on the effects of noise on behavior (appendix A) showed much concern about and too little substantiating evidence regarding ill results following exposure to noise. Even with the lower levels of sound present in the work environments of the early studies, considerable distress presumably was the product of contact by the experimental subject or the employee. No consideration had been given the intragroup relations present that could serve as determinants of stress tolerance, or how the worker viewed his job.

Any stress can be tolerated, if there is sufficient depth and meaning to the worker's position in his operational area. If he is accepted as a group member, if he feels he belongs, and if he believes that he is contributing to an effort of worth with which he can identify closely, then noise – even at the levels found at TAFB – can be handled by the employee, and eventually turned back by the employee as not bothersome or annoying. Not only has this been feasible, but the same employee has been capable of going beyond this point of adjustment. He has – when the structuring of the group has been logical and right – been able to demonstrate a level of morale rarely found in nonhazardous work locations.

In this study, variations in the workers' perceptions of their jobs were related to the internal factor of ego-involvement, and an attempt was made to discover the conditions which are associated with its development. This also turned out to be a complex problem. Emerging from this search are no discrete, cleanly separable variables which may be labeled "cause" and "effect." Rather, there is a complex of interdependent factors whose interaction influences the degree of worker morale. The effectiveness of these combinations of factors varies with the unique characteristics of the work groups studied. The very working conditions which were perceived so differently by the workers, as a consequence of their differing ego-involvements, are seen frequently to be basic factors in influencing the development of the same ego-involvements.

In Engine Test, ego-involvement was found to be associated with the worker's feeling of belonging to a group which was accomplishing a worth-while task. These attitudes developed from the cooperative nature of the work. The

men worked in groups and held interchangeable jobs. The completed engines served as reminders of their mutual accomplishment. In the welding unit, there was a reversal of working conditions. The welders worked alone, in individual booths. No cooperative effort was required, and the engine part on which they worked was of little concern to them. The job involved no group effort or common goal. The welders were found, however, to be as ego-involved as the engine testers, their interests having developed around pride in their chosen craft and in the quality of the weld itself. In spite of isolated working conditions, a group structure had sprung up on the basis of their common craft, and differences in morale among them were found to be associated with membership status in a clique which included the supervisor. The grinders also worked alone in booths on individual tasks. The situation called for no group cooperation. They had no common craft in which they could take pride, as did the welders. Their work was repetitive, unrewarded by the completed units which in the test block imparted a sense of accomplishment. Few of them knew the function of the part on which they were working. The grinders were not ego-involved; they were indifferent toward their work, and most of them wanted to transfer.

These contrasts show that while conditions vary, their psychologic effects are consistent. The conditions under which the employee works influence his feelings of usefulness, of importance, of belongingness, which are of prime importance to morale. It becomes apparent, then, that in dealing with the problem of morale, it is necessary to ask why these conditions produce in the workers the feelings which they do. The boredom of the grinders, for example, did not spring directly from the repetitiveness of their work. Welders were found, with equally repetitive tasks, who were enthusiastic about their jobs. The low morale of the grinders came about because the repetitive, fragmented nature of their work made it seem meaningless. They did not know what they were working on, nor could they see what they were accomplishing.

The grinder did not know why his work should be done in a certain way, and he blindly followed instructions. The situation afforded little opportunity for decision; the worker did not develop a sense of independence, responsibility, or mastery of his work.

These findings point directly to a need for increased employee training and education. The knowledge of the principles of the jet engine, its working parts, and how his own work relates to it, would provide objective data which would enable the worker on repetitive tasks to see where his efforts fit into the picture.

Another psychologic value resulting from a training program would be the worker's realization that he is regarded as a responsible member of his organization whose ability was being cultivated as a useful asset. These conditions should provide the groundwork for the development of the kind of ego-involvements which in Engine Test sprang from conditions which, by fortunate chance, were inherent in the nature of the work itself.

Another area in which worker interviews suggested a need for employee education is that of plant policy. It has been noted that few of the workers interviewed could give clear statements of procedures involving loan-outs, sick leaves, distribution of overtime, step-4 raises, etc. In the absence of objective information, the worker's evaluation of these policies was based on subjective factors, biased by his own feelings of morale. A clear explanation of how these schedules are handled might help to reduce charges of partiality and the feeling that supervisors and administrators at higher levels were indifferent to their needs and rights. Experimentally it has been demonstrated that in ambiguous situations, judgments become unstable and anxiety increases (41). Definite knowledge of plant policies might serve to reduce feelings of uncertainty and of the worker's being dealt with arbitrarily. Of special importance in this connection might be the problem of the anxieties about job security during slack work periods. In this plant of homogeneous workers, rumors of job cancellations or a reduction in force travel fast and create tensions. Definite information from supervisory personnel should help to alleviate these anxieties when the work load lightens.

As pointed out previously, job perception will vary with individual personality factors, so a program aimed toward increasing morale should emphasize worker preferences. Frequently, these are unpredictable, and must be handled on an individual basis. For example, several of the younger employees who were

interviewed spoke with distaste of their work on small engine parts – "that little old thing you can lift with one hand." They wanted to work with a heavier part which was difficult to lift. They felt the physical exertion would relieve tension and enable them to work better. Other workers, usually older, wanted work which did not require muscular exertion. Younger workers, ambitious to progress in their mechanical careers, wanted jobs where they could feel they were learning new things and improving their skills. Older men, with much of their careers behind them, were content with more routine jobs. Educational level, too, sometimes had an important bearing on job satisfaction and effectiveness. True educational achievement is not always reflected in the number of years of schooling reported. Some workers with a fourth-grade education had been able to make the most of their opportunities and to function adequately. Others with a reported eighth-grade education had difficulty in applying educational fundamentals. This is an especially important consideration in the case of supervisors, some of whom were found to have difficulty with "paper work" and who had to obtain help in writing letters recommending raises for the men under them: "We got one of the stenographers to write the letter for us. She knew where to put in the commas and things." The workers interviewed were quite definite in their job preferences and could outline clearly their reasons for liking certain types of work. The practical value of such preferences in job effectiveness is demonstrated by the fact that some of the most valid and widely used tests of vocational aptitude[6] sample interests, rather than abilities, on the premise that the worker will be most successful in the job which interests him most.

An area of central importance to worker effectiveness and morale is that of supervision. The majority of the supervisors and foremen interviewed expressed a need for more extensive training. The general feeling was that most of their experience had been "along mechanical lines" and that they were inadequately prepared to deal with personnel problems. Some who were dealing with difficult morale situations recognized the problem, but said they were at a loss to understand it or provide a solution. The worker's sense of accomplishment, of responsibility and of the importance of his work, which have been shown to be so basic to his morale, can be vitally influenced by relationships with his supervisor. A supervisory training program emphasizing the needs of the worker, the importance of group identifications, and the fostering of group consciousness by use of democratic procedure, the effectiveness of group decision, delegation of responsibility, and clarification of plant policies, should be profitable.

[6]Strong, E. K., Jr. Vocational interest blank for men. Stanford: Stanford University Press, 1938.

XVI. SUMMARY

I. *Introduction*

1. The hearsay at an Air Force base that workers exposed to extremely intense noise demonstrated the highest in morale, motivated a study to isolate the factors responsible – if the hearsay were true.

2. The project was planned so that 100 workers (jet engine testers) could be studied, with another 100 (welders and grinders) for controls, matched for age, race, sex, pay status, and length of service. The study would include personal interviewing, environmental noise measurements, psychologic testing, sociometric investigations, and reviews of illness-absence, injury experience, and frequency of visits to the industrial medical dispensaries on the base.

II. *Tinker Air Force Base*

3. Tinker Air Force Base, the site of the study, established at the outskirts of Oklahoma City in 1941, became the largest air depot in the world.

4. As one of eight air materiel areas, the base was engaged in the production or procuring, supply, and maintainance of all equipment and material needed to operate the Air Force.

5. In such a setting, with approximately 20,000 civilian employees, a study of the morale of workers engaged in a physically hazardous and potentially psychically traumatizing set of jobs – testing jet engines – was undertaken.

III. *Noise in contemporary industry*

6. Today, noise is encountered at sound pressure levels of 140 db with 180 db estimated for the future in jet operations.

IV. *Morale*

7. Morale has been looked upon as the spirit pervading a group that is enthusiastically united in the accomplishment of a common mission, with individual members whose estimates of their own prestige, status, and satisfactions are high.

V *Organization pattern*

8. The Study Group consisted of Aircraft Jet Engine Testers, Grades 10 and 15; and in the Control Group were Junior Aircraft Welders, Grade 15 and Grinding Machine Operators, Grade 10. All were in the Engine Test Section and Parts Overhaul Section of the Engine Branch, in the Shops Division, one of four in Depot Maintenance.

VI. *Noise exposure*

9. The noise to which the Engine Testers were exposed maximally, was measured at 119 db over-all level (sound pressure levels) with a speech interference level of 112 db. That of the Control Group was average factory noise of 76 db and an SIL of 58 db.

VII. *Conceptual approach to the problem*

10. In approaching the study of morale, we used the psychologic concept of ego-involvement (i.e., that from emotionally charged ego-attitudes spring the behaviors from which morale is deduced).

VIII. *Subjects and their jobs*

11. The skill requirements of the workers were classified as repetitive, average, and diversified, and the "social geography" of the jobs was identified.

12. Of the workers interviewed; 68 percent were born in Oklahoma, and 44 percent were in the 30- to 39-year-old group, with 23 percent in the 40- to 49-year-old category. Educationally, 78 percent had had high school education only.

IX. *Group relations study*

13. In the personal interviews, the workers were encouraged to talk about their social contacts, and their attitudes toward each other.

14. Sociograms were developed, encompassing a knowledge of the group structure, the leaders and dominant figures, the integration and cleavages, the clique formations, amount of social interaction, and hierarchical status of the members.

X. *Group relations among the engine testers*

15. The sociogram of the Engine Test group was characterized by integration of the entire group, and although there were clique formations, the relationships within them were subordinate to the outgoing relations among them. No cleavages were seen among sub-groups.

16. The cohesiveness among the engine testers was vigorous, and there were no complete isolates in the test cells.

17. In the personal interview material, greatly expressed was that the liking of the workers for their fellow employees was the reason for liking their jobs. There was cooperation, a willingness to help, a teamwork relationship, a sense of belonging, a democratic atmosphere, interdependence, and a sharing of responsibility.

18. Specific evidence was obtained of a common motivation – group goals and group norms determining attitudes and behavior in matters of interest to the group. The goal was to turn out a "good" engine which could be "sold" to the inspector. "Selling an engine" meant protecting a pilot's life, building a stronger air force, and making a better country.

19. Characterizing the informal group structure was the method of work allocation – supervisors gave the assignments to the workers in groups, leaving the men to work out the details of procedure, but with the supervisor standing by to offer help when needed.

20. Because of the basic attitudes of the workers toward their jobs, the unpleasant features of the work were minimized – the exposure to noise and outside temperatures; the job was greasy and the area was slippery; vibration was present; the threat of engine explosion was constant; and the potential danger of hearing loss was a daily threat.

21. Complaints stemmed not from the work per se, but from psychologically unfavorable features such as favoritism and inequities in giving raises, ratings, overtime, loan-outs, and getting "bumped" – a demotion.

22. Solidifying the group also was the mobility of the recorders who, by dividing their time between two jobs (preparation and testing) integrated social contact between operators and preparation line workers. Two separate lunch periods tended to break up habitual contacts leading to tight cliques. Of greatest importance was the fact that the purpose of

all of the work was tangible, concrete, and easily grasped.

XI. *Group relations among the welders*

23. Welders performed their work physically separated *from* others, and as independent units, without a cooperative effort to turn out a single product.

24. Clique formation was seen sociometrically among the workers, and beyond the immediate membership, social expansiveness dropped sharply. A clique of nine welders demonstrated high morale not seen in others of the group.

25. Nonclique welders attempted subgroup formations, but these were loose. In place of an integrated group with a common goal, there was a divided structure with a clear status hierarchy effected through a tightly knit clique, dominated by a few individuals.

26. The welding unit had a larger proportion of isolates and near-isolates.

27. Off-the-job social contacts took place about twice monthly, and included the supervisor as an active participant.

28. The clique welders enjoyed welding, and minimized the hazards of the job.

29. The nonclique welders centered their complaints around their isolation, their being dealt with arbitrarily, or *their being discriminated* against, and described their work as strenuous, unhealthful, "nerve-racking," and fatiguing. Strong were their expressions against loan-outs to inferior positions, and in regard to their feelings of insecurity during periods of slack work.

30. Although the welders were ego-involved in the welding trade, their membership in the immediate groups of welders with whom they would identify was of marginal character.

31. The welders' knowledge of organizational structure and function and personnel policies was minimal and confused. This was exaggerated by the vertical mobility of supervisors – promoted and demoted within a single work group.

32. Techniques of motivating employees or skills in understanding their problems were missed by the welding supervisors.

XII. *Group relations among the grinders*

33. Grinders operated alone, in booths, behind protective eyewear, and completed a work assignment on a single engine part, unrelated, in their knowledge, to the engine as a whole – a repetitive performance.

34. The grinders shared neither a chosen identification in a common, recognized craft (welding) nor in common effort and production goal (engine testing).

35. Their sociogram demonstrated a sparseness of friendship choices, tenuous connections, and the choices bespoke not a clique formation but a lack of activity. The number of isolates and near-isolates was high, and depicted a lack of group consciousness.

36. The feelings for transfer to other work were strong and frequent.

37. The grinders viewed their jobs as repetitive, as a continuous process, unpunctuated by complete units of work which they could regard with satisfaction. There was no meaningful whole on which they were working, and the parts they ground were without significance – no ego-involvement or identification with the work.

38. Although the hazards were of less potential danger in grinding than in engine testing, they were mentioned more frequently: dust, flying steel particles, noise, impaired illumination, "eyestrain," and standing.

39. Those grinders who expressed satisfaction with their work were older – they liked the minimal physical effort.

40. The one who liked grinding was an outstanding group member, and demonstrated the same capacity for minimizing job disadvantages as the engine testers and clique welders.

41. Further emphasis of the grinders' lack of involvement in their work is told by their interest in loan-outs to other departments.

42. The interviews, to the grinders, were of special significance – this was the first time "they had a chance to speak their piece to somebody who was interested and who wanted to understand them." The engine testers expressed the fact that they hoped their comments had been helpful.

XIII. *Job perception as a function of ego-involvement.*

43. To determine if groups will differ in the standards related to their work – as they do on basis of a relationship between ego-involvement and the manner of setting standards of performance – a specially devised scale, "E-Scale," was administered to groups, by job classification grade.

44. Results demonstrated that engine testers and welders were more selective in judgments

of job qualifications. There were no differences in E-Scale ratings between welders of different grade levels.

45. On testing of operators, recorders, and preparation line workers, there was no significant difference in E-Scale ratings.

46. Differences in salary rate, required skill, or in work classified as average or diversified are not prime factors associated with ego-involvements as measured in the scale.

47. Of interest was the fact that Grade 15 welders were more highly selective in their judgments of job qualifications than any other group.

48. These measurements point up the influence of motivational factors or judgment in a practical situation. Jobs rated by personnel analysts as requiring a comparable degree of skill, were judged by the workers to require much or little ability in proportion to their own feelings of morale.

49. Differences in morale among the welders relate to clique membership, and this was expressed further and matched by the E-Scale.

50. In essence, the E-Scale testing underscored the fact that perception varies with attitudes. Descriptions of working conditions – good or bad – represent actual perceptions of their work, influenced in part by motivational factors.

XIV. *Clinical data*

51. Data were secured from personnel and clinical records in order to correlate certain industrial behavior rates of the two groups. The absence frequency, absence disability, absence severity, and dispensary visit rates were computed and compared.

52. The Study Group as a whole showed a significantly lower absence frequency rate (average annual number of absences per workers), and the Negro members of the group had a similar lower rate.

53. The total Study Group had a significantly lower absence disability rate (annual average number of days absent per worker), as did the white segment of the group. In essence, the engine testers reported to work more often, and had fewer days of absence per year.

54. As Negro members of the Study Group demonstrated fewer absences also, and although in lower level work assignments, they shared presumably the morale felt by the testers.

55. In the Study Group, the white workers had a significantly lower absence disability rate than did the Negro employees of the group.

56. The dispensary visit rates showed a negligible amount of occupational illness for both groups, an almost equal occupational injury rate, and a dispensary visit rate for non-occupational illness for the welders and grinders of twice that of the engine testers.

57. Higher rates for occupational illness-caused absence were noted for the Study Group, but the welders and grinders showed higher absence disability and severity rates attributable to occupational injury.

58. Background data were studied, and there was no statistically significant difference between the two groups with respect to prior occupations. (Both groups showed a majority of their members as having come from a laboring or farming background.) There was no difference in prior major residence, and 90 percent of the Study Group and 84 percent of the Control Group came from the South Central area – essentially Oklahoma.

59. There were no significant differences between the groups in years of schooling. (The mean for the Study Group was 10.1 years, and for the Control Group 9.9 years.)

60. The mean years of service for the Engine Testers was 6.31 years, and for the welders and grinders, 5.65 years. No statistically significant difference was demonstrable.

Appendix A. *Literature review*

61. The body of literature relating to the effects of noise on behavior was reviewed to learn that much of the initial effort was as highly charged emotionally as it was thin in pertinent documented data. The early laboratory study settings did not match our contemporary "jet age" industrial situations.

62. Over the years, speculation gave way to controlled studies involving personnel exposed to 90-120 db of noise, and the opinion moved from one that viewed noise as all-harmful to one that granted that it might be annoying, but unproductive of a specific behavior response. Recognized, admitted, and substantiated was the clinical entity of occupational deafness. The other factor given credence was that noise did become bothersome when speech was masked, interfering with or eliminating verbal communication.

XVII. CONCLUSIONS

1. Factors such as noise, exposure to inclement weather, slippery operational areas, and potential explosiveness of work materials per se do not determine morale nor affect behavior on the job.

2. Morale results from the worker's perception of his working conditions and his job, and how the job is perceived is a function of ego-involvement.

3. Associated with ego-involvement are: a feeling of belongingness, a sense of responsibility, and an opportunity to contribute knowingly to a worthwhile effort.

4. A program of training can contribute greatly to an awareness of the needs of workers and the kinds of satisfactions they want from their jobs.

5. Through this awareness and understanding, workers will be given a feeling of respect, of worthwhileness, of importance – of being wanted.

6. Through a comparable program, workers can be apprised of personnel policies, and practices, so that a continuing knowledge can allay feelings of insecurity and develop a sense of stability. More important than the knowledge is the feeling that one is a needed part of the organization.

7. With these goals attained, illness-absenteeism and excessive visitation to the medical department should be self-rectifying, and support of the group's efforts – production – a natural and logical conclusion.

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REFERENCES

1. O C A M A Mission. Oklahoma City, Tinker Air Force Base. (n.d.)

2. Glorig, A. Field Investigations on Military Personnel as Regards Sound, in Noise, see ref. 98, supra. p. 101.

3. Philmus, L. C. Jet Noise Impairs Health, Says School of Aviation Medicine. *Am. Aviation* (March 14) 1955.

4. Miles, W. R. Immediate Psychological Effects, in BENOX Report – an Exploratory Study of the Biological Effects of Noise. Chicago, the University of Chicago, (Dec. 1) 1953, p. 84.

5. Ibid, p. 94.

6. Glorig, op. cit., p. 100.

7. Katz, D., and Hyman, H. Morale in War Industries in X. Industrial Morale, in Readings in Social Psychology, prepared for the Committee on the Teaching of Social Psychology of the Society for the Psychological Study of Social Issues. New York: Henry Holt and Company, 1947, pp. 437-447.

8. Perk, D.: Morale, *Ment. Hyg.* 35:19 (Jan.) 1951.

9. Brown, M.: Morale in Industry as Seen by a Neuropsychiatrist. Chicago, Zurich Insurance Companies, (Oct.) 1944.

10. Learner, D. B.: Psychological Factors of Morale. Research Report No. NM 001 058.21.02. Pensacola, U. S. Naval School of Aviation Medicine, Naval Air Station, (May 7) 1954.

11. Sherif, M., and Cantril, H.: The Psychology of Ego-Involvements. New York, John Wiley & Sons, Inc.

12. Chapman, D. W., and Volkman, J. A.: A Social Determinant of the Level of Aspiration, *J. Abnorm. & Social Psychol.* 34:225 (April) 1939.

13. Holt, R. R.: Level of Aspiration as Ego Defense, *Psychol. Bull.* 39:457 (July) 1942.

14. Postman, L., Bruner, J. S., and McGinnies, M.: Personal Values as Selective Factors in Perception, *J. Abnorm. & Social Psychol.* 43:142 (April) 1948.

15. Harvey, O. J.: An Experimental Approach to the Study of Status Relations in Informal Groups, *Amer. Sociological Rev.* 18:357 (Aug.) 1953.

16. Sherif, M.: An Outline of Social Psychology. New York, Harper & Brothers, 1947.

17. Mayo, E.: Human Problems in an Industrial Civilization. New York, The Macmillan Company, 1934.

18. _____: cited by Whitehead, T. N.: The Industrial Worker. Cambridge Harvard University Press, 1938.

19. Walker, C. R., and Guest, R. H.: The Man on the Assembly Line. Cambridge Harvard University Press, 1952.

20. Thrasher, F. M.: The Gang. Chicago, University of Chicago Press, 1927.

21. Whyte, W. F.: Street Corner Society. Chicago, University of Chicago Press, 1943.

22. Zorbaugh, H. W.: The Gold Coast and the Slum. Chicago, University of Chicago Press, 1929.

23. Moreno, J. L.: Foundations of Sociometry, an Introduction, *Sociometry* 4:15 (Feb.) 1941.

24. Lewin, K., Lippitt, R., and White, R. K.: Patterns of Aggressive Behavior in Experimentally Created "Social Climates," *J. Social Psychol.* 10:271 (Feb.) 1939.

25. Cameron, D. E.: Psychologically Hazardous Occupations, *Indust. Med.* 15:332 (May) 1946.

26. Weaver, E. K., and Zener, K. E.: The Method of Absolute Judgment in Psychophysics, *Psychol. Bull.* 25:466 (July) 1928.

27. Bruner, J. S., and Goodman, C. C.: Value and Need as Organizing Factors in Perception, *J. Abnorm. Psychol.* 42:33 (Jan.) 1947.

28. Proshansky, H., and Murphy, G.: The Effects of Reward and Punishment on Perception, *J. Psychol.* 13:295, 1942.

29. Dunker, K.: The Influence of Past Experience on Perceptual Properties, *Am. J. Psychol.* 52:255 (April) 1939.

30. Braly, K. W.: The Influence of Past Experience on Visual Perception. *J. Exper. Psychol.* 16:613, 1933.

31. Ansbacher, H.: Perception of Number as Affected by the Monetary Value of Objects, *Arch. Psychol.* No. 215, 1937.

32. Murphy, G., and Likert, R.: Public Opinion and the Individual. New York, Harper and Brothers, 1938.

33. Chapman, D. W., and Volkman, J.: A Social Determinant of the Level of Aspiration, *J. Abnorm. & Social Psychol.* 34:225 (April) 1939.

34. Hilgard, E. R., Sait, E. M., and Margaret, G. A.: Level of Aspiration as Affected by Relative Standing in an Experimental Social Group, *J. Exper. Psychol.* 27:411, 1940.

35. Lewis, H. B.: An Experimental Study of the Role of the Ego in Work, *J. Exper. Psychol.* 34:113 (April) 1944.

36. Frank, J. D.: Some Psychological Determinants of the Level of Aspiration, *Am. J. Psychol.* 47:285 (April) 1935.

37. Sears, P. S.: Level of Aspiration in Academically Successful and Unsuccessful Children, *J. Abnorm. & Social Psychol.* 35:498 (Oct.) 1940.

38. McGehee, W.: Judgment and the Level of Aspiration, *J. Gen. Psychol.* 22:2 (Jan.) 1940.

39. Sherif, C.: Ego-Involvement as a Factor ir Judgment, cited in Sherif, M.: An Outline of Social Psychology. New York, Harper and Brothers, 1948, pp. 289-292.

40. Harvey, O. J., and Sherif, M.: Level of Aspiration as a Case of Judgmental Activity in which Ego-Involvements Operate as Factors, *Sociometry* 14:121, 1951.

41. Sherif, M., and Harvey, O. J.: A Study in Ego Functioning: Elimination of Stable Anchonages in Individual and Group Situations, *Sociometry* 15:272, 1952.

42. Lindquist, E. G.: Statistical Analysis in Educational Research. Cambridge, The Riverside Press, 1940.

43. Noel, P. G.: Introduction to Mathematical Statistics. New York, John Wiley & Sons, Inc., 1947.

44. Fosbroke, J.: Practical Observations on the Pathology and Treatment of Deafness, *Lancet* 1:645, 1830.

45. Bauer, L. H.: Aviation Medicine. Baltimore, Williams and Wilkins, 1926, p. 32, p. 157.

46. Podolsky, E.: Noise, *Illinois M. J.* 67:478 (May) 1935.

47. Wells, W. A.: The Noises of Civilization and Their Evil Effects, *Tr. Am. Laryng. Rhin. and Otol. Soc.* 37:344, 1931.

48. Knudsen, V. O.: The Acoustical Spectrum, in Noise, see ref. 98, supra, p. 11.

49. Nelson, H. A.: New Legislation on Loss of Hearing. Workmen's Compensation Statistics. Statistical Release No. 3489. Madison, Statistical Department, Industrial Commission of Wisconsin, (Oct. 24) 1955, p. 27.

50. Kryter, K. D.: The Effects of Noise on Man. Monograph Suppl. No. 1 *J. Speech and Hearing Disorders,* 1950, pp. 1-95, cited by Corso (96).

51. Laird, D. A.: The Measurement of the Effects of Noise on Working Efficiency, *J. Indust. Hyg.* 9:431 (Oct.) 1927.

52. Hovey, H. B.: Effects of General Distraction of the Higher Thought Processes, Am. J. Psychol. 40:585 (Oct.) 1928.

53. Anon.: Foreign Letters, Berlin June 29, 1929, JAMA 93:397 (Aug. 3) 1929.

54. Laird, D. A., and Coye K,: Psychological Measurements of Annoyance as Related to Pitch and Loudness, *J. Acoust. Soc. of America* 1:158 (Oct.) 1929.

55. Anon.: Why Noise Annoys, Rev. of Reviews 82:108 (Nov.) 1930.

56. Dennis, E. B., Jr.; Noise: Its Measurement, Effect, and Control, *New York State J. Med.* 30:573 (May 15) 1930.

57. Laird, D. A.: The Effects of Noise: A Summary of Experimental Literature, *J. Acoust. Soc. of America* 1:256 (Jan.) 1930.

58. Archambault, L.: Effect of Noise on Nervous System, *New York State J. Med.* 32:1110 (Oct. 1) 1932.

59. Laird, D. A.: Noise Does Cut Production, *Forbes* 30:13 (Aug. 15) 1932.

60. Pollock, K. G., and Bartlett, F. C.: Two Studies in the Psychological Effects of Noise. 1. Psychological Experiments on the Effects of Noise. Report No. 65, London, Industrial Health Research Board, 1932. Weston, H. C., and Adams, S.: Two Studies in the Psychological Effects of Noise. II. The Effects of Noise on the Performance of Weavers. Report No. 65. London, Industrial Health Research Board, 1932.

61. Purdy, J. S.: Noise, a Nuisance Dangerous or Injurious to Health, *M. J. Australia* 1:46 (Jan. 9) 1932.

62. Smyth, H. F.: Noise in Industry: Its Effect on Hearing and on General Health (A Review of the Literature). *Ann. Otol. Rhin. and Laryng.* 41: 1108 (Dec.) 1932.

63. Harmon, F. L.: The Effects of Noise upon Certain Psychological and Physiological Processes, Arch. Psychol. 23:1 (Feb.) 1933.

64. Laird, D. A.: The Influence of Noise on Production and Fatigue, as Related to Pitch, Sensation Level, and Steadiness of the Noise, *J. Appl. Psychol.* 17:320 (April) 1933.

65. Fryer, D.: A Genetic Study of Motivation Under Changing Auditory Situations, *Brit. J. Psychol.* 24:408 (April) 1934.

66. Fryer, D.: Motivation Effects of Auditory Timing upon Repetitive Mental Work, *Brit. J. Psychol.* 25:140 (Oct.) 1934.

67. McKenzie, D.: Noise and Health, *Brit. M. J.* 2:636 (Oct. 6) 1934.

68. Weston, H. C., and Adams, S.: The Performance of Weavers Under Varying Conditions of Noise. Report No. 70. London, Industrial Health Research Board, 1935.

69. Lindahl, R.: Noise in Industry, *Indust. Med.* 7:664 (Nov.) 1938.

70. Morgan, C. T., and Morgan, J. D.: Auditory Induction of the Abnormal Pattern of Behavior in Rats, *J. Comp. Psychol.* 27:505 (June) 1939.

71. Behnke, A. R.: Noise in Relation to Hearing and Efficiency, *New York* State J. Med. 40:1080 (July 15) 1940.

72. McCartney, J. L.: Noise Drives Us Crazy, *Pennsylvania M. J.* 44:1402 (Aug.) 1941.

73. McCord, C. P., and Goodell, J. D.: The Abatement of Noise, *JAMA* 123:476 (Oct. 23) 1943.

74. Sabine, P. E.: The Problem of Industrial Noise, *Am. J. Pub. Health* 34:265 (March) 1944.

75. Berrien, F. K.: The Effects of Noise, *Psychol. Bull.* 43:141 (March) 1946.

76. Egan, J. P., Stevens, S. S., Waterman, T. H., Miller, J., and Knapp, R. H.: Effect of Airplane Noise on Human Efficiency, *J. Acoust. Soc. of America* 18:530 (Jan.) 1947.

77. Miller, G. A.: The Masking Effectiveness and Annoyance Value of Various Types of Auditory Stimuli, *Am. Psychologist* 1:237 (July) 1946.

78. Stevens, S. A., Egan, J. P., Waterman, T. H., Miller, J., and Knapp, R. H.: The Effect of Airplane Noise on Human Efficiency, *Am. Psychologist* 1:283 (July) 1946.

79. Anon.: Jet Engine Noises Found Harmless to Shopmen, *Science Newsletter* 54:41 (July 17) 1948.

80. Davis, H.: Biological and Psychological Effects of Ultrasonics, *J. Acoust. Soc. of America* 20:605 (May) 1948.

81. Finkle, A. L., and Poppen, J. R.: Clinical Effects of Noise and Mechanics Vibrations of a Turbo-Jet Engine On Man, *J. Appl. Psychol.* 1:183 (Sept.) 1948.

82. Mendelson, E. S., Poppen, J. R., Kornfield, A. T., and Wagner, H. G.. Turbo-Jet Engine Noise – Vibrational Frequencies Encountered in Engine Test Cells, *J. Aviation Med.* 19:365 (Oct.) 1948.

83. Siirala, U., and Lahikainen, E.: Studies of Deafness in Shipyard Laborers, *Acta Oto-laryng.* Supp. 67, 1948, p. 118.

84. Sleight, R. B., and Tiffin, J.: Industrial Noise and Hearing; *J. Appl. Psychol.* 32:476 (Oct.) 1948.

85. Dickson, E. D. D., and Watson, N. P.: A Clinical Survey into the Effects of Turbo-Jet Engine Noise on Service Personnel. Some Preliminary Remarks, *J. Laryng. and Otol.* 63:276 (May) 1949.

86. Grove, W. E.: Will Noise Damage One's Hearing? *JAMA* 140:674 (June 25) 1949.

87. Hanley, T. D., and Williamson, R. S.: The Effect of Various Noise Levels on Performance of Three Mental Tasks. Technical Report – SDC 104-2-21. Lafayette, Purdue Research Foundation, Purdue University, (Dec. 15) 1950.

88. Smith, K. R.: Intermittent Loud Noise and Mental Performance. AF Technical Report No. 6368. Dayton, United States Air Force, Air Materiel Command, Wright-Patterson Air Force Base, (Dec.) 1950.

89. Barrett, A. M.: Personality Characteristics under the Stress of High Intensity Sound. Unpublished doctoral thesis, Pennsylvania State College, 1951.

90. Blau, T. H.: Effects of High Intensity Sound on Certain Psychological Variables. Unpublished doctoral thesis, Pennsylvania State College, 1951.

91. Davis, H.: Effects of Noise on Human Behavior and Communication, *A.M.A. Arch. Indust. Hyg. and Occup. Med.* 3:227 (March) 1951.

92. Dickson, E. D. D., and Chadwick, D. L.: Observations on Disturbances of Equilibrium and Other Symptoms Induced by Jet-Engine Noise, *J. Laryng. and Otol.* 65:154 (March) 1951.

93. Miller, H. G.: A Study of the Interference Effects of High Intensity Sound on the Retention of Visually and Auditorically Learned Material. Unpublished doctoral thesis, Pennsylvania State College, (Aug.) 1951.

94. Tufts College Institute of Applied Experimental Psychology: Handbook of Human Engineering Data, ed. 2. Technical Report No. SDC 199-1-2 Washington, Special Devices Center, Office of Naval Research, 1951, Part IV, Chap. IV, Sec. 11.

95. Zintz, F. R., and Kerr, W. A.: Hearing Loss and Worker Morale, *J. Appl. Psychol.* 35:92 (April) 1951.

96. Corso, J. F.: The Effects of Noise on Human Behavior. WADC Technical Report 53-81. Wright-Patterson Air Force Base, Wright Air Development Center, (Dec.) 1952.

97. Kryter, K. D.: Noise Safety Criteria, *AMA Arch. Indust. Hyg. & Occup. Med.* 5:117 (Feb.) 1952.

98. Kryter, K. D.: Noise and Behavior, *in* Noise – Causes, Effects, Measurements, Costs, Control. Ann Arbor, University of Michigan, 1952.

99. Broadhent, D. E.: Noise, Paced Performance and Vigilance Tasks, Brit. J. Psychol. 44:295 (Nov.) 1953.

100. Davis, H.: Survey of the Problem, in BENOX Report – An Exploratory Study of the Biological Effect of Noise. Chicago, the University of Chicago (Dec. 1) 1953, pp. 12-20.

101. Dickson, E. D. D.: Some Effects of Intense Sound and Ultrasound on the Ear. *Proc. Roy. Soc. Med.* 46:147 (March) 1953.

102. Larsen, B.: Occupational Deafness Including Some Remarks on the Auditory Fatigue and Adaptation, *J. Laryngol. and Otol.* 67:536 (Sept.) 1953.

103. Meyer, A. J.: Noise as a Factor in Health, *Am. J. Pub. Health* 43:978 (Aug.) 1953.

104. Rosenblith, W. A., Stevens, K. N., and the staff of Bolt, Beranek, and Newman: Handbook of Acoustic Noise Control. Vol. II Noise and Man. WADC Technical Report 52-204. Wright-Patterson Air Force Base, Wright Air Development Center, Air Research and Development Command, United States Air Force, (June) 1953, Chap. 17, Effects of Noise on Human Behavior.

105. Davis, H., Eldredge, D. H., Glorig, A., Newman, E. B., Parrack, H. O., and Phoebus, C. P.: High-Intensity Noise and Military Operations: An Evaluation. CHABA Report No. 1. St. Louis, Armed Forces-National Research Council Committee on Hearing and Bio-Acoustics, (Jan. 27) 1954.

106. Ganguli, H. C., and Rao, M. N.: Noise and Industrial Efficiency. A Study on Indian Jute Weavers. Arbeitsphysiol. 15:344 (April) 1954. Abstracted by Hickish, D. E., *in Bull. Hyg.* 29:1235 (Dec.) 1954.

107. Cunningham, W. J.: Noise, *Amer. Scientist* 43:490 (July) 1955.

108. Newman, E. B.: Psycho-Physical Effects of Noise, *Noise Control* 1:16 (July) 1955.

109. Rosenblith, W. A.: Effects of Noise on Man: Problems for Study, *Noise Control* 1:22 (July) 1955.

APPENDIX A
LITERATURE REVIEW

Although noise has attended man's working efforts through all the historical changes in industrial methods, a review of professional opinions rendered over the years will permit a firmer base for understanding the Study at TAFB. It was in 1830 that Fosbroke (44) first intimated a causal relationship between occupational noise and impaired hearing. It was almost a century later (45) that the first comment was made connecting the development of occupational deafness with noise from aircraft engines in operation: "...all aviators become deaf...," and "The constant roar of a high powered motor causes diminution of hearing," wrote Bauer. Since 1926, however, the relevant literature has become voluminous, but characterized by "reports from observation, anecdotal accounts, and a few systematic experimental investigations." With the increased mechanization encountered in the 1930's in manufacturing, transportation, and the development of new industries, the subject of noise became the focus of public attention. Many words and numerous writings appeared which condemned noise as the *bête noire* responsible for all of the evils of the contemporary world. In 1935 one author's (46) emotionally charged pen produced this description of the world of sounds about him:

> With the coming of the Machine Age came noise, a whole orchestra of strident discords, clangs and clashes, a cacophony of whistles, horns, rattles, sirens, rivetings and fusty roars. To many noise meant progress; more noise, more progress. Civilization moved along, shod in sandals of steel, tramping lustily and heavily. In the cities where the benefits of civilization are more in evidence they are more noisily in evidence: airplanes roaring overhead, street cars, motor buses, automobiles, their engines grinding out a mechanical tone poem of motion; subway trains underground, clanging along on steel rails; factory whistles, traffic cops, peddlers, rending the air hideous with an ungodly melange of shrieks, screams, groans and roars. As if this is not enough, magnovoxed radios send out a constant, interminable blare, day and night, of jazzy orchestras, throaty tenors, screechy sopranos and crazy elocutors to mingle with the already noise-stifled air.

Following along sequentially, he continues, and implies a multiplicity of dire doings as resulting from these cacophonous goings-on:

> It has been noted that there has been a decline in the birth rate in all civilized countries coincident with the Machine Age. The birth rate in England and Wales in 1877 was 36.2 per 1000; in 1928 it was only 16.7. From similar high rates in the United States it fell to 18.2; in France to 18.2; and in Germany to 18.6. Wherever machine civilization and its necessary noise is not a factor the rates have remained high. In Ceylon in 1828 the rate was 40, and in Egypt it was 43.3. Students of the noise problem have assigned to noise a very important part in causing this decline.

And further he writes picturesquely, but undocumentedly:

> The rising incidence of mental disease noted in all civilized countries in recent years is even more serious than the declining birth rate. In this country the inmates in the institutions out-numbered those in hospitals for all other causes. It is not an exaggeration at all to say that quite a few cases of insanity are caused by nervous systems which cannot adjust themselves to the constant bombardment of noise.

Interestingly enough, four years before, these now familiar sentences were found as the product of another and possibly original author (47):

> It may or may not be significant that there has been a steady decline of the birth-rate in all civilized countries which dates from the beginning of the machine age. . . . Of much greater importance than the falling birth-rate is the rising incidence of mental diseases, which has been noted in all civilized countries in recent years. This has gone on until at the present time in the United States for example, we are confronted by the appalling reality that the inmates in the institutions for the insane and feeble minded out-number those hospitalized for all other disabilities combined. . . . The significance of this increase in relation to noise cannot be ignored because of the experimental proof on the one hand of the influence of noise upon brain function and on the other the clinical testimony to the fact that mental derangement is often directly traceable to this cause.
>
> One factor as already mentioned is the strain which induces mental fatigue and irritability; another no doubt the loss of sleep and rest which have been recognized as potent causes of mental breakdown.
>
> Consideration of these factors, pointing to the detrimental influence of noise upon intellectual faculties, brings us face to face with the question whether or not noise, the inevitable accompaniment of the higher civilization should not be accounted civilization's worst enemy.

Noise control was a prominent subject from the boom years of the 20's to the late depression years immediately preceding World War II. Experimental observations by psychologists began to appear; they pointed to some adverse effects of noise on work output and efficiency, along with some subjective complaints from those in the experimental situations. In the late 20's and early 30's, investigations began to explore the ill effects of noise in simulated office situations with comparable over-all noise levels. The belief was that work conducted in distracting environments caused annoyance, fatigue, excitability, nervous tension, impaired operational efficiency, and muscular stiffness. Although many of these studies were carried out under carefully controlled conditions, the experimental settings did

not compare with our present-day work circumstances or with our high sound pressure levels. Not considered were certain emotional factors, and as stated by Barrett (89), "...the individual perceives with his whole personality as well as his body... the individual brings to the situation his sum total of personality characteristics, traits, habit patterns or previous conditioning. The individual uses his personality constantly and perceives things in his own way... the individual reacts to a situation not only with his intellect but with his feelings and emotions as well. In a sense, he perceives affectively as well as sensory; and his subjective reports are colored by his own particular affective pattern."

Little consideration was given to this in the early studies. During this same period sound engineers busied themselves in attempting to reduce the intensity of the sound produced by normal office and manufacturing activities by means of absorbing wall materials in tile or plaster forms, or through use of acoustic insulation, such as ear defenders.

Concomitantly added to the literature were the comments that noise was definitely harmful in another direction – it produced an occupational hearing impairment or deafness. With this point, however, we are not concerning ourselves in this study. This one ill effect has been recognized and accepted as an end result of prolonged exposure to noise on the job (48) and, as an example, the law in one state (49) "provides compensation for occupational deafness due to prolonged exposure to noise in employment."

Interest in noise abatement programs continued, but still there were few scientific building blocks that could be assembled into a solid, valid structure of knowledge. Mistakenly and loosely used as synonyms were the terms "annoying" and "harmful." No distinction was drawn as it is now in industrial hygiene between the concepts of "absorption" and "intoxication." Because exposed persons were annoyed, it was assumed also that they were harmed. Individual susceptibilities were recognized during and after World War II, and it was accepted that considerable adaptation to air-borne sound did take place.

With the War's end more attention was given to airplane-generated noise, and with the appearance of jet-propelled craft, a new body of physiologic folklore was born. All varieties of ills – psychic and bodily – were accredited to both sonics and supersonics. During this period of developing legend, investigators were observing that subjects under the stress of noise, although annoyed, did perform mental tasks well and in an unimpaired fashion, and occasionally were motivated to a better performance when noise was present. Recognized though, were the facts that high intensity sonic frequencies, upper frequencies, and discontinuous sound were more annoying than the opposite phenomena, but not necessarily detrimental to morale or production.

Corso (96) has summarized much of the early work by this comment: "Despite the conclusions that noise detracts from efficiency and well-being under many circumstances, the results of the studies reported are inadequate for the formulation of positive noise efforts or general performance trends."

Kryter's 1950 monograph (50) offered a succinct analysis of the relation of noise to human behavior with these remarks:

1. Most studies reporting detrimental effects of noise or work output are subject to criticism due to poor experimental techniques and uncontrolled variables.

2. Experiments conducted with adequate controls indicate that steady or expected noises do not adversely affect psychomotor activity to a significant degree.

3. Psychological and physiological adaptation and, perhaps, increased effort on the part of the subjects can account to a large extent for the general ineffectiveness of noise on work output and psychomotor performance.

4. Most studies conducted in this problem area have been confined to non-auditory work tasks, thereby neglecting the important factor of required communication and minimizing the effects of noise on performance.

APPENDIX B

E-SCALE STATEMENTS GROUPED BY "TRAITS"

I. Responsibility:

Mr. A. doesn't worry about whether he is doing more than his share. He is often the first to see extra things to be done, and he takes responsibility for doing them.

Mr. B. recognizes his responsibility for doing his own work right, but does not feel responsible for anything that he has not been told to do.

Most of the time Mr. C. is a steady worker, but some times he has to be reminded that the work is his responsibility.

Most of the time Mr. D. finishes his work on schedule, but he wants somebody else to take responsibility and see that it is done right.

As long as Mr. E. feels that he is doing his job as he has been told and is trying hard, he doesn't feel responsible for things that go wrong.

II. Initiative:

Mr. F. doesn't stop when he has learned all about his own job. He finds out how other jobs are done too, and knows how the whole operation works. He makes the most of his knowledge.

Mr. G. knows his own job well, and can usually go ahead on his own. When a new problem comes up, he needs detailed explanation and supervision.

Mr. H. knows the difference between good and poor work, but he couldn't explain why a job must be done in a certain way.

Mr. I. does his job the way he has been taught. He is not the kind of person who asks why, but he does carry out instructions well.

Mr. J. can be depended upon to carry out instructions if they are detailed. When he has finished one job, he waits for his supervisor to give him another one.

III. Judgment:

Mr. K. is known for his sound judgment and usually works things out right. People often ask his advice about job matters.

In ordinary situations, Mr. L. uses fairly good judgment. But when especially important matters arise, his decisions about his work need to be checked by his supervisor.

Mr. M. doesn't depend upon his own judgment alone, but gets along fairly well by asking others for advice about his work. He usually follows the suggestions others give him.

Mr. N. sometimes gets in a hurry and may make mistakes because he hasn't thought the matter through. His supervisor checks his work frequently to prevent errors.

Mr. O works well on jobs where he doesn't have to make many decisions for himself. He likes to have most of his work planned for him.

IV. Independence:

Mr. P. is good at thinking up better ways of doing things and his suggestions have been used to improve service.

Mr. Q. plans his work well by thinking out the methods which suit him best, but he does not think of suggestions for general improvement of service in his unit.

Mr. R. has never thought up ways of improving his work methods himself, but he watches others and uses their way of doing things if it is better than his own.

When Mr. S. has learned to do things a certain way, he will go ahead with it even when his work has changed and some other way might be better. But he can learn a better method if someone shows him how.

Mr. T. does not know how to plan his work for best results, but depends on someone else to show him how, and he can follow his instructions.

V. Intelligence:

Mr. U. has always been quick to understand things, and he usually catches important points which others miss. Everybody respects his opinion.

Mr. V. is about as smart as the average person. Some things are hard for him to learn, but he knows enough to get along as well as most people.

Mr. W. says he was always slower to learn than most people, but if he takes enough time, he can usually understand, and he remembers well what he has learned.

Mr. X. has trouble learning new things if they are at all complicated. Sometimes things have to be explained to him several times, but he gets along all right when he doesn't have to remember very many things at once.

It is hard for Mr. Y to learn anything new, and he does not understand very well why things must be done in a certain way. When he has learned a job, he is a steady worker, but needs help if anything new comes up.

APPENDIX C

APTITUDE SURVEY AND SOCIOMETRIC QUESTIONNAIRE

APTITUDE SURVEY

Name_____ Unit_____

What, in your opinion, are the abilities which make for success in your work? You be the judge and rate the men described below on how successful you think they would be in your own job. Consider for each one only the ability described. Rate each man 1, 2, 3, 4, or 5, according to the following key:

1--Excellent, the best
2--Better than average.
3--As good as the average.
4--Rather poor, but could probably stay on the job.
5--Should not be hired for a job like mine.

___ Most of the time Mr. C. is a steady worker, but some times he has to be reminded that the work is his responsibility.

___ Mr. I. does his job the way he has been taught. He is not the kind of person who asks why, but he does carry out instructions well.

___ Mr. M. doesn't depend upon his own judgment alone, but gets along fairly well by asking others for advice about his work. He usually follows the suggestions others give him.

___ As long as Mr. E. feels that he is doing his job as he has been told and is trying hard, he doesn't feel responsible for things that go wrong.

___ Mr. R. has never thought up ways of improving his work methods himself, but he watches others and uses their way of doing things if it is better than his own.

___ Mr. H. knows the difference between good and poor work, but he couldn't explain why a job must be done in a certain way.

___ Mr. F. doesn't stop when he has learned all about his own job. He finds out how other jobs are done too and knows how the whole operation works. He makes the most of his knowledge.

___ Mr. O. works well on jobs where he doesn't have to make many decisions for himself. He likes to have most of his work planned for him.

___ Mr. G. knows his own job well and can usually go ahead on his own. When a new problem comes up, he needs detailed explanation and supervision.

___ Mr. B. recognizes his responsibility for doing his own work right, but does not feel responsible for anything that he has not been told to do.

___ Mr. J. can be depended upon to carry out instructions if they are detailed. When he has finished one job, he waits for his supervisor to give him another one.

___ Most of the time Mr. D. finishes his work on schedule, but he wants somebody else to take responsibility and see that it is done right.

Key:

1--Excellent, the best.
2--Better than average.
3--As good as the average.
4--Rather poor, but could probably stay on the job.
5--Should not be hired for my job.

___ Mr. N. sometimes gets in a hurry and may makes mistakes because he hasn't thought the matter through. His supervisor checks his work frequently to prevent errors.

___ Mr. V. is about as smart as the average person. Some things are hard for him to learn, but he knows enough to get along as well as most people.

___ Mr. T. does not know how to plan his work for best results, but depends on somecne else to show him how, and he can follow their instructions.

___ Mr. Q. plans his work well by thinking out the methods which suit him best, but he does not think of suggestions for general improvement of service in his unit.

___ Mr. K. is known for his sound judgment and usually works things out right. People often ask his advice about job matters.

___ Mr. X. has trouble learning new things if they are at all complicated. Sometimes things have to be explained to him several times, but he gets along all right when he doesn't have to remember very many things at once.

___ In ordinary situations, Mr. L. uses fairly good judgment. But when especially important matters arise, his decisions about his work need to be checked by his supervisor.

___ Mr. P. is good at thinking up better ways of doing things and his suggestions have been used to improve service.

___ It is hard for Mr. Y. to learn anything new, and he does not understand very well why things must be done in a certain way. When he has learned a job, he is a steady worker, but needs help if anything new comes up.

___ Mr. A. doesn't worry about whether he is doing more than his share. He is often the first to see extra things to be done and he takes responsibility for doing them.

___ Mr. W. says he was always slower to learn than most people, but if he takes enough time, he can usually understand, and he remembers well what he has learned.

___ Mr. U. has always been quick to understand things, and he usually catches important points which others miss. Everybody respects his opinion.

___ When Mr. S. has learned to do things a certain way, he will go ahead with it even when his work has changed and some other way might be better. But he can learn a better method if someone shows him how.

PLEASE BE SURE TO FILL IN THE FIRST THREE CHOICES, AND THEN AS MANY AS YOU LIKE.

If you could ride to work with anybody you like, whom would you choose:

1st Choice _____

2nd Choice _____

3rd Choice _____

4th Choice _____

5th Choice _____

6th Choice _____

7th Choice _____

8th Choice _____

9th Choice _____

10th Choice _____

11th Choice _____

12th Choice _____

If your foreman were to be absent for several weeks, whom would you recommend to takes his place while he was gone?

1st Choice _____

2nd Choice _____

3rd Choice _____

4th Choice _____

5th Choice _____

6th Choice _____

7th Choice _____

8th Choice _____

9th Choice _____

10th Choice _____

11th Choice _____

12th Choice _____

Whom would you prefer to eat lunch or play cards with?

1st Choice _____

2nd Choice _____

3rd Choice _____

4th Choice _____

5th Choice _____

6th Choice _____

7th Choice _____

8th Choice _____

9th Choice _____

10th Choice _____

11th Choice _____

12th Choice _____

Suppose you want advice about a problem that comes up on your job. Whom would you talk it over with?

1st Choice _____

2nd Choice _____

3rd Choice _____

4th Choice _____

5th Choice _____

6th Choice _____

7th Choice _____

8th Choice _____

9th Choice _____

10th Choice _____

11th Choice _____

12th Choice _____